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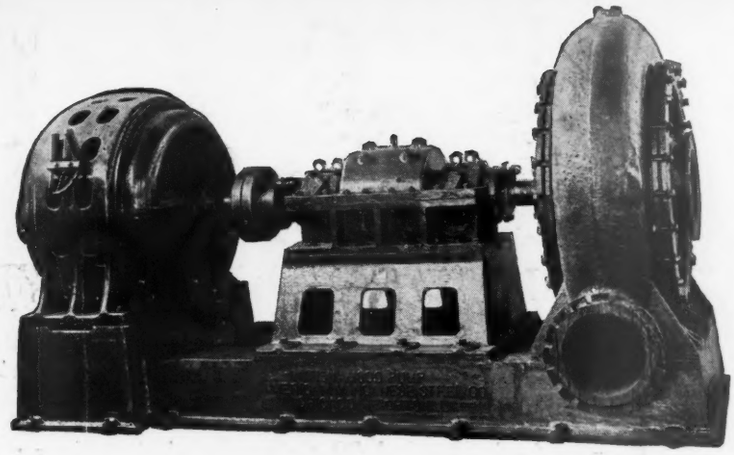

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Pit and Quarry

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Stretching Out to Meet Changing Pit Conditions

This is the Barber-Greene Conveyor that grew up

WHEN the Barber-Greene Portable Conveyor was first installed at the washing plant of Homer J. Holl, N. Canton, Ohio, it easily handled the daily capacity. But pit conditions changed and a longer conveyor was needed. So the Barber-Greene was stretched out by the addition of extra sections—until it became a full fledged permanent conveyor.

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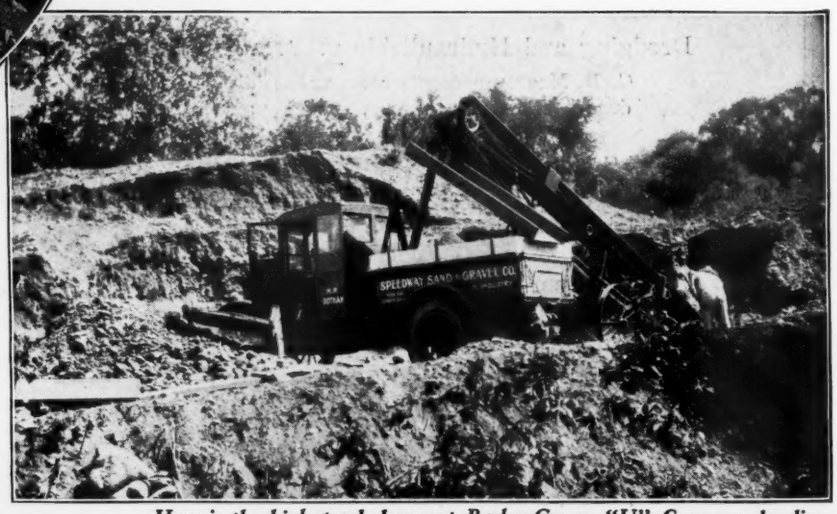

Here is the high-speed, low cost Barber-Greene "U" Conveyor loading gravel at a small pit. This B-G is a real money maker on the smaller jobs.

The owner of this South American plant believes in saving money. Three Barber-Greenes—a Permanent Conveyor, an "N" Conveyor, and a Bucket Loader are cutting costs for him.

The outfit can handle 250 yards per day with ease.

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If you're interested in what Barber-Greenes can do in pit and gravel work, send for detailed layouts and information on the jobs they are handling. There's no obligation.

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DREDGING AND HYDRAULICKING

By G. B. Massey

HYDRAULIC dredges are extremely useful tools where it is necessary to excavate material and convey it with slight or no increase of elevation to a distance not to exceed about one mile. Hydraulic dredges are often used where other excavating equipment would answer the purpose as well or better. On the other hand, there are a great many cases in which a hydraulic dredge could be used to tremendous advantage in place of the excavating and transporting equipment now in use. In a general way it may be said that the hydraulic dredge accomplishes by power and with a minimum of labor that which can be accomplished by other means with less power, but with a much higher labor charge.

The advent of the Diesel engine in suitable sizes and speeds for hydraulic dredges has tremendously reduced the cost for power and this reduction in the cost of power affects the hydraulic dredge more than any other type of excavating equipment, so that where the hydraulic dredge was formerly holding its own when steam driven, it now has a very decided advantage in a great many cases. For sand and gravel, which generally has to be washed before it is fit for use, the mixture of nine parts of water and one part of sand and gravel forms a washing process which can be taken advantage of if the discharge is properly handled.

If the hydraulic dredge were considered only as a digging machine with a zero length of discharge pipe it would appear at a disadvantage when comparing the costs with excavating machines of other types. On the other hand, the transporting of the material through the pipe from the point of ex-

A Typical Dredge In the Florida Phosphate Fields

cavation to the point of delivery is very economical, not nearly so economical as handling the material in the dry on a belt conveyor, but infinitely more economical than can be done by such transportation units as trucks or railroad equipment.

It is not practicable to pump to greater distances than given below with the size of dredge listed:

6 inch— 500 feet.
8 inch—1,000 feet.
10 inch—1,500 feet.
12 inch—2,000 feet.
16 inch—3,000 feet.

Hull Material

Hydraulic dredge hulls do not require the same stiffness as dipper dredge hulls because they do not have to be pinned up and are not subjected to the same twisting strains. A great many hydraulic dredge hulls are of timber and it makes a perfectly satisfactory material with proper design and construction. Steel hulls for dredges which are to operate continuously in one locality are preferable.

There are two general methods of construction. One is to have the machinery on deck, thereby permitting of two longitudinal bulkheads forming foundation for winch, the dredging pump and the main engine and forming stiffening members for the spud keepers and the ladder, trunnions and A frame trunnions.

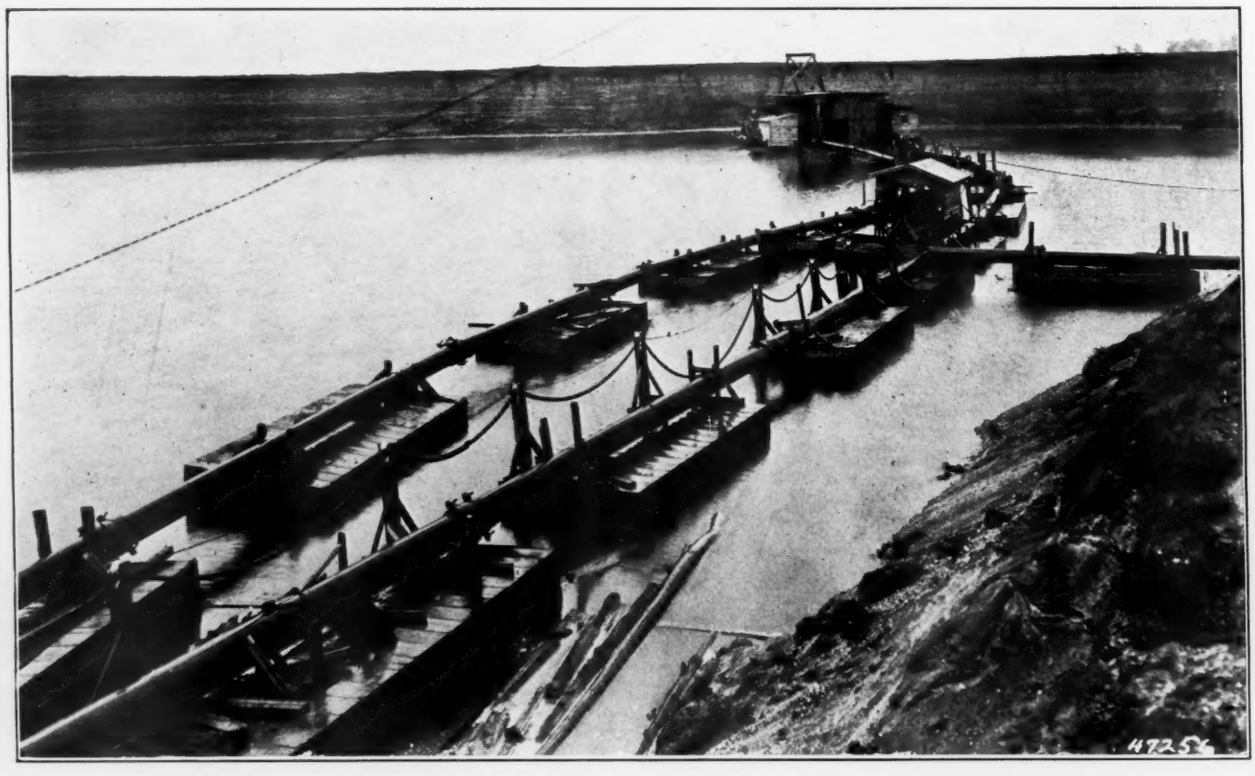
Where machinery is mounted in the hold the center bulkheads have to be spread and the machinery is then mounted on heavy floors or floor beams extending from one bulkhead to the other. When the machinery is in the hold it is customary to have several thwartship bulkheads extending to the deck, separating the hold into several watertight compartments. If there are enough of these compartments it is possible to flood one of them without sinking the dredge.

With the steel construction, especially if the house is also of steel, the fire hazard is reduced to a minimum, whereas it is always present with timber construction. The timber hull and the steel hull for the same dredge would weigh about the same. The timber hull would cost considerably less to build, but would require more attention and repairs and would not last as long as the steel hull.

Hull Shape

The size of the dredge hull depends upon the weight of the hull and the machinery which will be mounted on it. This weight calls for a certain displacement of water, and circumstances govern the draft, which in turn governs the length and the width or the beam. The width or the beam is governed largely by the question of transverse stability, which means that the dredge will not tip from side to side with the movement of various heavy machine parts from one side of the dredge to the other.

As a rule, the beam of a hydraulic dredge with respect to the length of the dredge is greater than in the case of the ditching dipper dredges, because a hydraulic dredge cannot dig its own channel of a width just sufficient to allow the dredge hull to pass, as is the case with a ditching dipper dredge, which usually gets its stability while working from bank spuds. The hydraulic dredge beam with re-



A Double Pontoon Line

spect to its length is less than in the case of harbor dipper dredges, which have to be broad enough to give the proper spread of the two vertical forward spuds so that the trim of the dredge will not be affected by the swinging of the heavy boom and the dipper.

It is quite customary to cut away the forward corners of the dredge so as to give an opportunity for the cutterhead to reach the side of the cut before the dredge hull does. This cutting away depends upon the length of the dredge, the length of the ladder, the width of channel to be excavated and the location of the spuds.

As a rule the draft varies from 2½ feet for the small dredges up to 4 or 5 feet for the large dredges, the beam varying from about 15 feet for a 6 inch dredge up to 24 to 30 feet for the large machines. The total depth of the hull, of course, is made up of the draft and the freeboard or the part of the hull which projects above the water surface. The freeboard is decided upon after taking into consideration the nature of the service in which the dredge will be used. If in exposed waters where waves of considerable height would be experienced the freeboard could be made much greater than in the case of a dredge which would work in small rivers and protected waters, where the freeboard would not have to be more than 2 feet, whereas in the large dredges working in exposed locations the freeboard is often as much as 5 feet. With the exception of the cutting away at the bow, the hydraulic hull is apt to be box shaped with the exception of a well at the bow for the suction bladder and rounded knuckles, which are of better construction than square corners in the bilges.

As hydraulic dredges are usually towed stern first, there is often a desire expressed to have a rake at the stern so as to facilitate towing. This, however, is not desirable as it practically does away with the lower spud keeper at the bottom of the hull and makes it necessary to build up at the stern a structure with considerable elevation to hold the upper spud keeper, the lower spud keeper being at the deck level. Where all the digging is to be done in fairly shallow water requiring only short spuds, this arrangement could be designed on a small scale with less spread between the upper and lower spud keepers and would thus permit of a rake at the stern.

There have been cases where dredges have been towed a long distance where a false rake has been built for temporary use at the stern of the dredge.

There have also been dredges built where the two spuds are set in wells in the rake at the stern and also some where the spuds have been placed forward of the stern in tubes extending through the hull and requiring a complete lifting out of a spud when it becomes necessary to change spuds. The location of the spuds at the stern is preferable because the discharge line is led out at the stern beside the digging spud so that the swinging of the dredge about this spud causes the least amount of motion of the floating discharge line.

For digging narrow channels and discharging over a dike alongside of the channel the spuds can be located near the middle of the dredge so that the bow and stern both swing. In this way a narrower cut can be made than with the spuds at the stern. In one sand and gravel operation the two spuds are on the side with the discharge pipe

A Clamshell Dredge

led out from the side. This is a special arrangement which is satisfactory in the location in which it is used, but would not prove so satisfactory for general use.

Gantries

In addition to the ladder there are three frames or structures which are necessary to the hydraulic dredge. These are the A frame, the forward or bow gantry, and the stern or spud gantry. The A frame is pin connected to the bow of a dredge and extends upward and forward at an angle of about 45 degrees, its outer end taking the upper block or blocks of the ladder support tackle. The location of this outer point of the A frame should be such that it is high enough above the water so that the ladder can be raised to a horizontal position without interference and should be far enough forward from the bow of the dredge so that it is slightly forward of the lower block when the ladder is working at an angle of 45 degrees below the water surface. This means that when the ladder is in a horizontal position the lower block of the ladder hoist tackle is well forward of the upper one.

The A frame has to be cross-braced and at times is used as a support for the swinging ropes on their way from the winch drum to the two blocks at the forward end of the ladder. By being pin connected to the hull, the ladder can vibrate or take a new position, due to a stretch of the guy ropes, without throwing any strain on the hull. Theoretically the A frame is not subjected to side strains as the pull exerted on the swinging line is exerted almost directly at the point of resistance, which is the cutterhead itself.

The bow gantry is usually a rectangular frame with two legs and one or more cross pieces, the upper cross piece and the legs being designed to take the various strains of the guy ropes and gusseted. This gantry is also pin connected to the dredge on the large machines. There is also usually a cross member part way up the bow gantry from which are suspended sheaves for the swinging ropes.

The stern gantry is provided for the purpose of hoisting two stern spuds and is designed not only to hoist the weight of these spuds, but to pull them out of the soft bottom, so that the strength required is in excess of the strength required to lift the spuds only. Except in case of towing, one spud is of course on the bottom, while the other is

Interior View of Dredge Showing Oil Engine

being hoisted. The spuds are allowed to drop of their own weight, the drop being somewhat retarded by the necessity of preventing the spud ropes from piling up slack when the spud comes to rest.

The spud gantry is usually supported in its position in a fore and aft direction by two stiff legs projecting forward at an angle and pin connected both at the deck and near the top end of the spud gantry. These stiff legs are usually cross braced to support each other. At the top of the spud gantry is a cross member from which the upper spud blocks are suspended.

The width of the spud gantry across the dredge is sufficient with suitable gusset plates to require no side guy lines and stiff legs to hold it in place fore and aft, so that no guy lines are required, although they are sometimes used to connect the spud gantry with the bow gantry. All of these frames, of course, can be of timber and the ends can be arranged in cast iron sockets to take the place of pin connections, but the best equipment calls for steel structural work throughout with pin connections with cast steel feet and shoes.

Ladder Factors

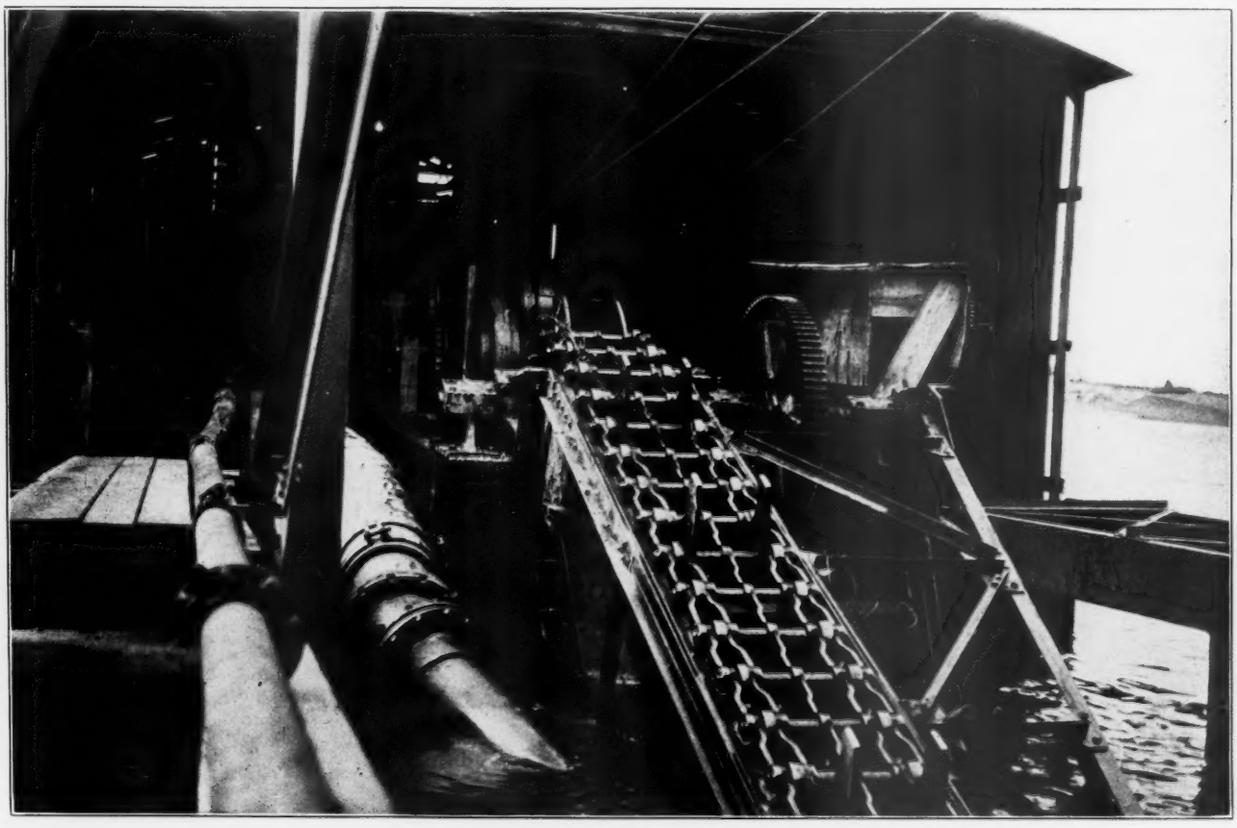
The ladder is usually spread at the point of connection with the dredge so as to take care of the side strains caused at this point while the dredge is in use. The forward end of the ladder is contracted of a width just sufficient to give the necessary strength at that point and to take care of the suction pipe.

The length of the ladder depends upon two things. The first is the depth to which it is desired to dredge, the ladder being made of a sufficient length so that the cutterhead will clean up the bottom at that depth when the ladder occupies a position at 45 degrees below water surface. The second factor influencing length of the ladder is the minimum width of channel the dredge will have to dig where the original ground surface is at such an elevation as not to provide draft for the dredge itself. If the dredge is required to dig a channel through an area where the original ground surface does provide draft for the dredge, this second factor does not have to be considered.

The ladder frame usually consists of two main structural members properly gusseted and cross braced for rigidity and connected to the dredge either by independent pin connections or by other means in conjunction with the suction pipe at the bow, as will be described later.

Agitating Device

With certain classes of material, namely, very light silt or muck without much fiber substance, they are drawn into the mouth of the suction pipe by the velocity of the water just outside the entrance to the suction pipe. The same is true of certain sands. These classes of material can, therefore, be pumped without the necessity of agitating, but even with these materials an agitating device



Looking Into a Dredge Showing Agitator and Hoist

will usually increase and stabilize the output sufficiently to warrant its use.

Materials which do not respond quickly to the flow of the water at the mouth of the suction pipe can sometimes be lifted from their position sufficiently by means of a jet of high pressure water, so that before they settle again they will be acted upon by the current and carried into the suction mouth. It is usual to arrange these high pressure jets in a ring surrounding the suction mouth with the jets all parallel to the axis of the suction pipe and to each other.

Another type of agitator is the mechanical one, which consists of a spider mounted on the end of a shaft in such a way as to be immediately forward of the suction mouth. On this spider are either removable straight blades or curved blades, sometimes with removable teeth for very hard digging and in some classes of material with certain fixed openings between the blades so as to prevent automatically cobbles and other matter from being drawn into the pipe which could not be handled by the pump. The blades on these cutterheads are arranged so that the forward end of the blade starts the cutting, which is followed up by the after part of the blade. This tends to keep the cutterhead from being shoved out of the bank.

As the cutterhead is designed to revolve in one direction only, it follows that in hard material, if the dredge were being swung from right to left in facing forward and the cutterhead revolutions were clockwise, the cutterhead would tend to pull down, and this pulling down is resisted by the up-pull of the ladder hoist tackle. If, however, the dredge is swinging from left to right and the cutterhead is revolving in a clockwise direction and encountered hard material, the only thing that would keep the cutterhead cutting into the material would be the weight of the forward end of the latter, and if this weight were not sufficient the cutterhead would tend to ride up and ride along on top of the hard material.

It is evident from this that the hydraulic dredge operates to much better advantage on one direction of swing than the other and it is usually arranged, therefore, to swing the dredge more slowly in the effective direction and more rapidly in the other direction. In easy digging material, of course, the difference is not so great in the efficiency on the two swings.

As a rule it may be stated that the open type of cutterhead with the straight blades is suitable for material which does not contain sticky clay or cobbles and that for both classes of material the bird cage or basket type of cutter is better. The basket type of cutter is also better for extremely hard digging because of the fact that both ends of the cutter blade are supported, whereas in the open type the support is at the middle part of the blade.

In the case of the bird cage or basket type of cutterhead the lower end of the ladder is fitted with a large suction head which closes off the back end of the cutter and incorporates in itself the mouth of the suction pipe, which is usually flattened so that it is elliptical with the narrow axis vertical. With the open type of cutter there is no particular reason for closing in the rear end of the cutterhead and so the suction head is merely a long heavy bearing with suitable legs for attaching to the ladder and

Dredge With Rear Discharge

also arrangements for supporting the end of the suction pipe.

Cutterhead Drive

The cutterhead is supported on the cutterhead shaft, which is carried in bearings suitably spaced on the ladder and is fitted at the upper end with a large spur gear or bevel gear forming part of a train of gears which speed up the revolutions sufficiently so that some sort of drive may be applied. The various types of drive are: A small quarter crank two cylinder simple steam engine, the electric motor or a pulley driven by a belt from a shaft or other mechanism.

In the case of the large trunnions, one of the shafts of the ladder drive passes through the center of this trunnion, allowing of the location of the motor or engine on the dredge hull itself, rather than on the ladder. With another type of drive the cutter shaft is connected to a fore and aft shaft on the dredge by means of a universal joint, the gear reduction in this case being entirely on board the dredge. The revolutions per minute of the cutterhead shaft depend largely upon the class of work and the diameter of the cutterhead itself.

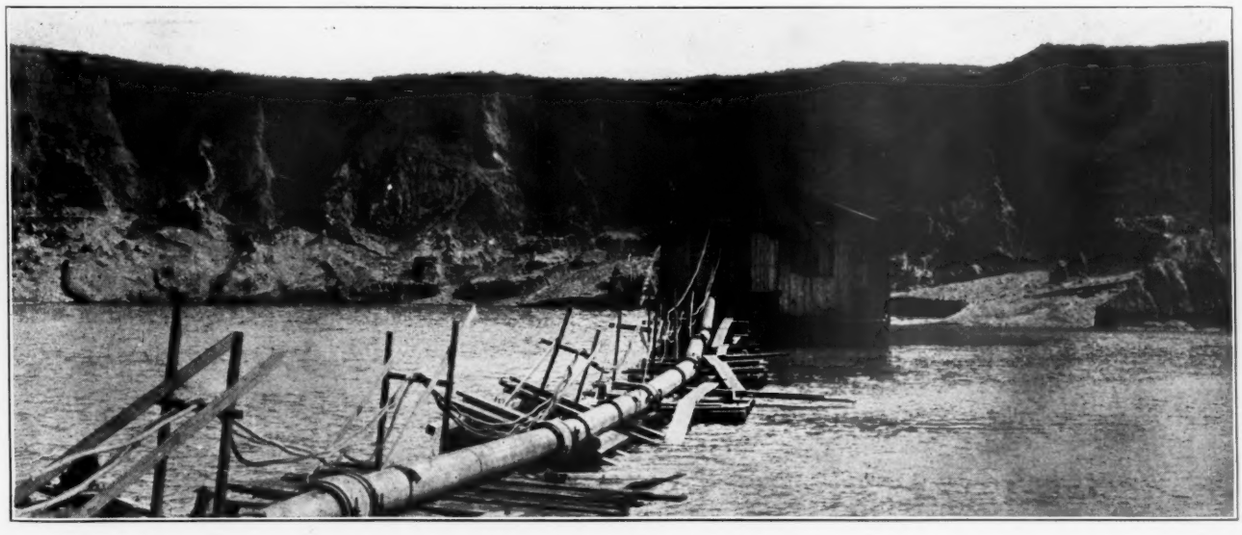
Auxiliaries

Of course the main requirement of power on a hydraulic dredge is the dredging pump, but there are other units which require power and it always requires considerable thought as to how best to provide for these units; namely, the winch, the cutterhead, priming pump, the air compressor for starting a Diesel engine, the service pump, etc.

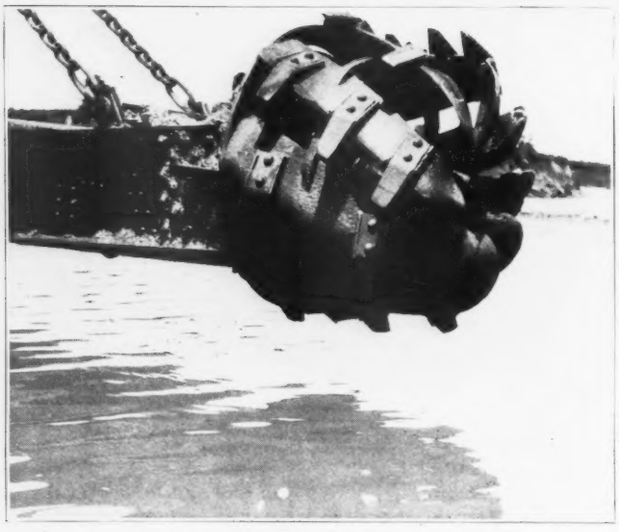
One solution is to have a separate electric motor or internal combustion engine for each unit and this usually is done on the steam dredges, each unit having its own steam engine. The second arrangement is to provide one auxiliary engine driving an electric generator which supplies power for electric motors driving all of the units. This is a popular arrangement. A third plan is to drive an electric generator by means of a silent chain drive off the shaft of the main engine driving the dredging pump, this generator providing current for the electric motors on various units. Another arrangement is to take the power from the main engine by means of belts or rope drive direct to the units through a general countershaft provided for the purpose.

Close Up of Dredge With Ladder and Cut

The most elaborate, expensive and best arrangement is to have the auxiliary engine driving a generator for each motor required for the auxiliaries. This is known as the Ward-Leonard system and provides for voltage control and, therefore, speed control, the torque increasing as the speed decreases, which, of course, is ideal for the driving of a winch or cutterhead, but not necessary in the case of an air compressor, priming pump, service pump, etc., which can all be driven from one generator. In the case of electrical equipment, all of the controllers should be located at the operating



Very Typical of the Sand and Gravel Dredging Operation Working In Artificial Lakes Rotary Cutter



Close-up View of Rotary Cutter

Showing Method of Raising and Lowering Agitation

platform and in the case of the countershaft the friction clutch levers should be brought to the operating platform.

Flexible Joint at Bow

The ladder is flexibly connected at the bow of the dredge by pin connections so that it can be raised and lowered in a vertical plane. Any tendency toward lateral motion in the ladder with respect to the dredge is resisted by the pins in the two legs of the ladder, which are spread sufficiently to give necessary leverage.

Several types of flexible joints are in use, the simplest one being a smooth bore rubber suction hose so located that the center of the hose coincides with a line drawn on the center line of the two pins. Another type of flexible joint is the ball joint, which if used is better located beneath the water surface on account of air leakage. A third type of joint is made possible by substituting for the fulcrum pins two large diameter trunnions hollow and permitting of the suction pipe being carried through one trunnion and the cutter drive through the other trunnion. This necessitates a

Typical River Dredge

well in the bow of the dredge and is more used than any other type.

A still further joint is a joint of the same type as the last, but with the swinging joint located with its center exactly on the center of the trunnion pins and about midway betwen them. This joint has the disadvantage of having three revolving joints, all of which have to be exactly in line, which is mechanically undesirable. Still another joint is one with a goose neck at the upper end of the ladder, which is inserted and withdrawn from a slightly larger goose neck which is located on the bow of the dredge. This calls for very exact workmanship and is very little used.

In general, it is, of course, best to have as few curves as possible in the pipe line and whatever curves there are should be of long radius, but there are often mechanical objections to an otherwise theoretically ideal arrangement. The ladder should not work at an angle of more than 45 degrees with the water surface and it should be possible to raise the ladder to a horizontal position for inspection. This gives a maximum movement of 45 degrees for the ladder and this is the motion which has to be considered in designing the flexible joint at the bow. Of course, the suction pipe would never be filled with water with the cutterhead out of water and therefore the flexible joint is only required to function satisfactorily, so far as the water passage goes, through angles of about 35 degrees.

Pipe on Dredge

The pipe on the dredge is flanged and consists usually on the smaller dredges of lap welded steel pipe threaded and flanged with heavy elbows of cast iron. On the larger dredges the pipe is often cast steel.

A leak in the suction pipe will not flood the dredge while the pump is in operation, but it might be apt to sink the dredge if the suction pipe enters below the water level and the pump is not in operation. A bad leak in the discharge pipe, where it passes through the hold of the dredge, is very apt to sink the dredge unless it is run through comparatively small compartments or is enclosed in a sheet steel jacket as is sometimes done. This sheet steel jacket is of light gauge steel, surrounding the entire pipe with tell-tale pipes discharging above the deck, so that any break in the discharge pipe causes one of these tell-tale pipes to spout out on the deck.

The three special fittings usually provided in the hull piping are in the handhole elbow or straight section at the suction mouth of the pump, which is provided at this point as this is the most likely location for any foreign material to cause stoppage. The handhole may be obtained in a 90 degree elbow, 45 degree or on a straight section of pipe. The elbow connection is preferable because it enables materials to be removed more readily through it.

The stone box is provided on some dredges and is located in the suction pipe between the bow of the dredge and the suction entrance of the pump. This stone box is usually plate steel or at times a cast box which is so placed that it permits large stones to drop into the box and be held there and thus kept out of the pump. A door is provided through which the material collecting in the box can be dumped through the bottom of the dredge. All dredges are not provided with the stone box, the necessity for its use being a large number of cobbles and boulders which very nearly approach the maximum size which the pump will pass without difficulty.

On the discharge side of the pump and close to the pump in a horizontal section of piping there is located an enclosed flap valve which has two purposes, the first one being to isolate the pump from the rest of the pipe line for priming purposes, and the second is to isolate the pump from the pipe line in case of sudden shutting down of the pump when pumping at considerable static head, which would mean that all of the water in the pipe line would flow back through the pump unless prevented. The flap valve is equipped with a lever which makes it possible to hold the valve open from the outside or to hold it tight shut against a small pressure.

On dredges which have to be dismantled and moved from time to time there is a certain advantage in having a more flexible joint than a flange joint. Such a joint is the Victaulic joint, which is applied to the pipe by cutting a shallow groove around each pipe near the end. Into this groove a clamp fits, which clamp not only holds the two pipes together, but contains a rubber ring which makes a vacuum or pressure tight joint and yet allows of the pipe being rotated or being flexed 5 degrees while under pressure. This allows of a slight variation in position of the different units without affecting the piping.

On small dredges the pipe is usually entirely on deck, which is, of course, the safest place for it, but on large dredges the pipe is so large and the lower elevation of the pump means that practically all of the suction and discharge pipe are located in the hold of the dredge.

Winches

A hydraulic dredge without a cutterhead requires only three drums on the winch or hoist, the middle drum for hoisting the suction pipe and the two side drums for maneuvering the dredge. A hydraulic dredge equipped with cutterhead requires a winch with five drums, one for the ladder, two for hoisting the spuds and two for the swinging lines.

There are two general types of five drum winches. One has the drums all on one shaft extending across the boat and an intermediate or countershaft transmitting the drive to the drum

shaft through one set of spur gears or from the intermediate shaft to the drums themselves by means of a pair of spur gears for each drum. On the highest grade winches of this type the drum shaft does not revolve, the gears are all gear rims of cast steel with cut teeth, and independent friction clutches are located on the intermediate shaft for driving each drum. Each drum is equipped with either a standing brake or hand brake, the standing brakes being on the swing lines.

The other type of five drum winch is arranged with the drum shafts extending across the dredge, but with two or more drums in parallel, one forward of the other. With this arrangement shorter independent shafts are used and any distortion of the dredge hull and, therefore, to some extent, of the winch frame, has no effect on the shorter shafts connected through spur gearing but is apt to bind the long shaft. For this reason the long shaft winch is more or less confined to the smaller dredges where the drums are short and the shaft can also be short enough so that it will not suffer from distortion.

The ladder hoist drum and the two spud drums have to take only a small amount of rope and can, therefore, be very short in the barrel, whereas the swinging drums have to take a large amount of rope and are therefore longer in the barrel. The advantage of the long shaft winch is that the lead of the ropes is such that they require a minimum number of sheaves.

Levers

There are two possible locations for the operator of a hydraulic dredge, one at the winch location, in which case the levers may or may not be banked; the other location is in the pilot house usually located above the winch, in which case the levers have to be banked, which means brought to one location so that they can all be handled with a minimum amount of walking back and forth.

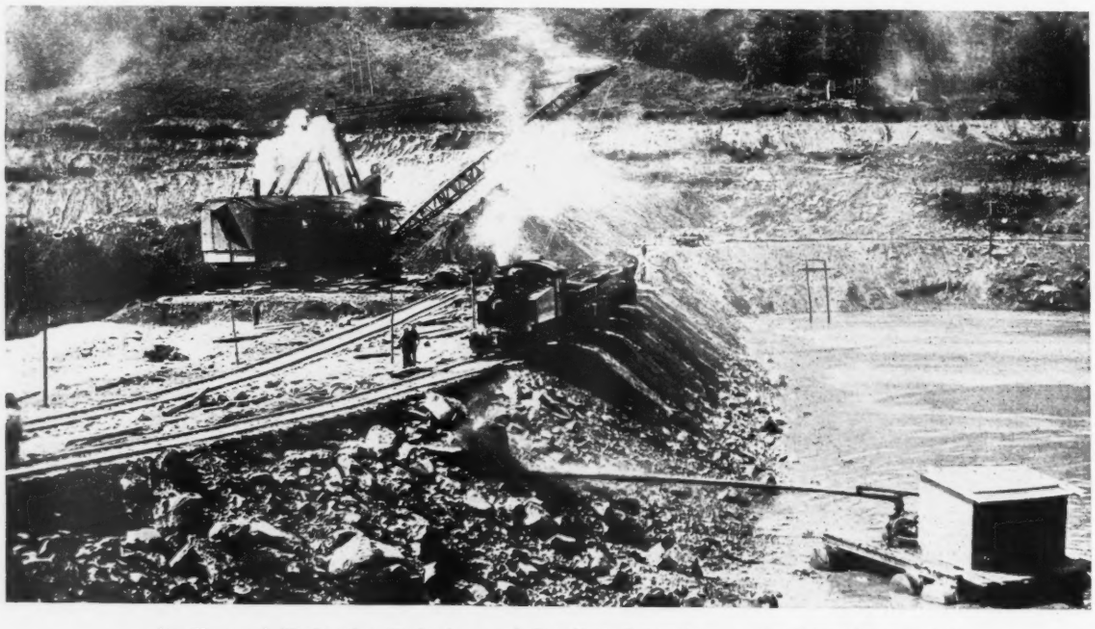
The levers connected with the maneuvering of the dredge consist, therefore, of five clutch levers and three or five brake levers for the winch alone. In addition to these levers there are usually a whistle cord, means for shutting off the power, the vacuum gauge for the suction pipe, pressure gauge for the discharge pipe and a pressure gauge for air or water for priming purposes.

Spuds

There are two spuds on hydraulic dredges with cutterheads. These spuds are located at the stern of the dredge, one on each side of the center line and a sufficient distance apart so that they may be used alternately while swinging in order to move the dredge forward in the cut. One of these spuds is used entirely while operating and is known as the "digging spud," while the other one is used only during the moving ahead operation and is known as the "walking spud."

The two spuds are identical in their details of design and construction and are, of course, interchangeable as regards digging and walking, but once a cut is started with one spud as the digging spud it usually so continues at least until the end of the cut. Often where one spud is damaged it is used as the walking spud, the perfect one being reserved for digging.

The "pinning-up" operation is not required on a hydraulic dredge as is the case on a dipper dredge. The only machinery required, therefore, is the method of hoisting them and they are allowed to drop their own weight overhauling the hoisting line. As the dredge swings about the digging spud as a pivot while working, the spuds are round in section and consist either of solid timber or steel tubing or the larger sizes of built up steel sections with diaphragm plates. The spud points are cast iron or cast steel, the points being comparatively



An Unusual Hydraulic Stripping and Loading Operation in the Phosphate Field

sharp and cone shaped so as to sink into the bottom sufficiently to maintain the fulcrum point fixed.

The strains on the spud are caused by the necessity of holding the stern of the dredge at a fixed point while the bow is being pulled from side to side by means of the swinging lines which exert a pull on the ladder at a point behind the cutterhead. The swinging line is pulling the dredge sideways and the cutterhead is being held to the material to be excavated and, therefore, offers considerable resistance, and some of this effort is transmitted to the stern spud. There also is a tendency to push back on the spud, as the cutterhead is tapered and, therefore, tends to crowd the dredge back as it works.

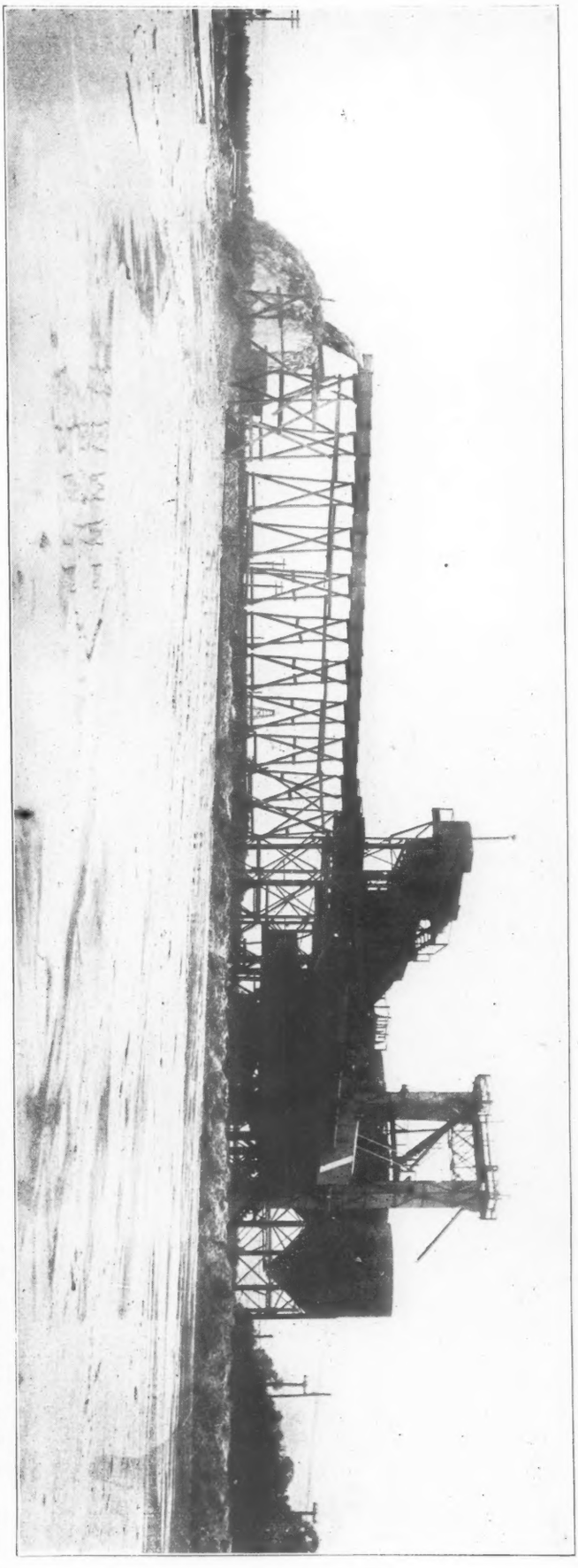
Each spud is held to the dredge by means of two spud keepers, which usually are heavy cast steel sockets at the stern, the outer half of the socket being hinged and pin connected so that a spud can be removed without hoisting it through the keepers. These keepers have to be some distance apart so as to exert their restraining influence on the spud at points as far apart as practicable. The lower one is usually located on a line with the bottom of the hull and the upper one is located at the deck line or on a special frame work which is built up above the deck line so as to get a better position.

The spuds are hoisted by means of a wire rope tackle with one block fastened to the top of the spud and the other hanging from the spud gantry. The size of wire rope used should be small enough not to require too large diameter sheaves for the blocks and yet should be large enough so that the number of parts in the tackle should not be greater than absolutely necessary, as the dropping spud overhauls this line and the greater the number of parts, the greater the speed of the line when the spud actually hits the bottom and stops.

On smaller dredges the spuds are hoisted in various ways. It is possible, of course, to have a sheave at the level of the deck, or a slight distance above it, and a line running over this sheave and down close to the point of the spud, at which point it can be attached. This means, of course, a single line and a small spud on a small dredge.

Another type of hoisting equipment is to have a forged steel band which fits loosely around the spud and is sufficiently wide so that it really forms a very short cylinder. When the spud is down, the rope to which this cylinder is attached at one side can be slacked off and the cylinder slides down the spud freely, but when a strain is put on the rope the cylinder cocks up sufficiently to prevent its slipping on the spud and in this way hoists the spud, but, of course, eccentrically.

Both of these last mentioned methods are used on small dredges, but on large ones are considered as a make-shift, the high or gallows frame type being very superior and mechanically correct.



Showing Method of Returning Waste in a Florida Phosphate Hydraulic Operation

TABLE I
TOTAL HEAD IN FEET AGAINST WHICH PUMP WILL DELIVER

R.P.M.	Diameter of Impeller in Inches										
	20	22	24	26	28	30	32	34	36	38	40
200											
250							21	24	27	30	33
300				20	23	27	30	34	38	43	48
350			23	27	32	36	41	46	52	58	65
400		26	30	35	42	48	54	61	68	76	84
435	25	30	36	42	49	56	64	72	80	90	100
490	31	38	45	53	62	71	81	91	102	113	127
575	43	53	64	74	86	98	114	125	140	157	175
680	60	74	88	102	118	137	156	175	195		
750	74	89	107	125	147	166	190				
870	98	120	144	168	196						
1050	144	175									
1160	175										
	6"		8"			10"			12"		

TABLE II
FRICTION HEAD IN FEET PER 100 FEET OF PIPE
Clear Water

Diameter Pipe	Velocity in Feet Per Second						
	10	11	12	13	14	15	16
6"	6.2	7.5	8.8	10.3	12	13.5	15.3
8"	4.7	5.6	6.6	7.7	9	10.1	11.5
10"	3.73	4.48	5.20	6.16	7.10	8.11	9.18
12"	3.11	3.73	4.40	5.13	5.92	6.77	7.65

Pontoons

Small pontoons, for the smaller size of hydraulic dredge, are made by constructing a timber framework which is supported by steels drums, which can be obtained in two sizes, namely, 55 gallons and 110 gallons capacity. The frame may be made of such a size as to accommodate the necessary number of barrels to give flotation and sufficient stability. Where this type of pontoon is used it is customary to use one of them near each end of each pipe.

There is another type of pontoon which has been used to a considerable extent, especially in smooth water. This arrangement consists in fastening alongside of the discharge pipe on either side a pontoon made of a piece of pipe with the ends closed.

The pontoon, which theoretically answers the requirements best, is one which has sufficient length with respect to the pipe it supports so that a piece of pipe separated from the rest of the discharge line will always remain horizontal. The width of the pontoon should be such as to give proper transverse stability under rough water conditions.

With the length and the width of ample dimensions, as they have to be to answer the above requirements, the necessary displacement could be obtained with a small draft. The bottom should be a deep spoon shape so as to make it possible to move the pipe line about easily and also to minimize not only the impact of waves on the side of the pontoon, but also to minimize the rocking motion which would be caused by waves passing under the pontoon.

TABLE III
CUBIC YARDS SOLIDS EXCAVATED PER HOUR

VELOCITY IN FEET PER SECOND	% Solids	5	6	7	8	9	10	11	12	13	14	15
						6 Inch Pipe						
	10	13.1	15.8	18.4	21	23.6	26.3	29	31.6	34	37	39.5
	11	14.3	17	20	23	25.8	28.6	31.4	34.4	37	40	43
	12	15.5	18.7	21.8	25	28	31.2	34.2	37.4	40.5	43.6	47
	13	16.8	20	23.6	27	30.4	33.8	37	40.5	44	47	50
	14	18	22	25	29	33	36	40	44	47	51	54
	15	19	23	27	31	35	39	43	47	50	54	58
	16	21	25	29	33	37	41	46	50	54	58	62
						8 Inch Pipe						
	10	23	28	32	37	42	46	51	55	60	65	70
	11	25	30	36	41	46	51	56	61	66	71	77
	12	28	33	39	45	50	56	61	67	72	78	84
	13	30	36	42	48	54	60	66	72	79	85	90
	14	32	39	45	52	58	65	71	78	84	91	97
	15	35	42	49	56	63	70	77	84	91	98	105
	16	37	44	52	59	67	74	81	89	96	103	111
						10 Inch Pipe						
	10	36	43	50	58	65	72	79	87	94	101	108
	11	40	48	56	63	71	80	87	95	103	111	119
	12	43	52	60	69	78	87	95	104	112	121	130
	13	47	56	66	75	85	94	103	112	122	132	141
	14	50	61	71	81	91	101	111	122	131	142	152
	15	54	65	75	86	97	108	118	129	140	151	162
	16	58	69	81	92	104	116	127	139	150	162	173
						12 Inch Pipe						
	10	52	63	73	83	94	105	115	126	136	147	157
	11	57	69	80	92	104	115	127	138	150	162	173
	12	63	75	88	100	113	126	138	151	164	177	189
	13	68	82	95	108	123	137	149	164	178	192	204
	14	73	88	102	117	132	147	161	177	191	203	220
	15	78	94	110	125	141	157	172	190	205	222	236

Where pontoons are built of timber they are usually built along simpler lines, but where they are built of steel there is no reason why they should not be made so as to minimize the strains on the flexible joints and the pipe which make up the discharge line. In places where there is a swift current and the pipe line has to be led across the current, there is an advantage in being able to swing the axis of the pontoon so as to be parallel with the current. This involves some type of turn-table on top of the pontoon.

Discharge Pipe

The floating discharge pipe of a hydraulic dredge may consist of:

1—Spiral pipe is the cheapest and lightest pipe that can be used.

2—A spiral seam pipe is used with a high carbon steel wearing strip rolled into the seam. This pipe also being light weight and the wearing strip materially increasing the life of the pipe.

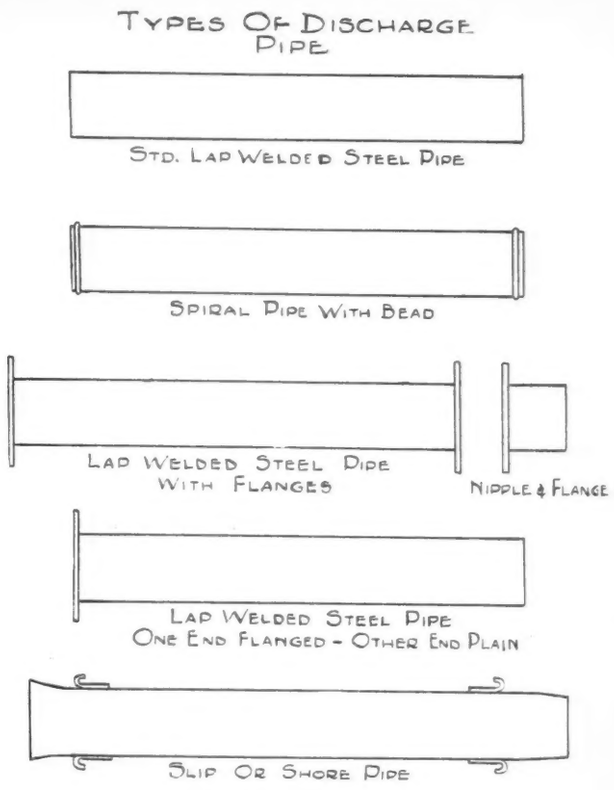
Both of these pipes mentioned above are usually supplied with the interior diameter varying by one inch from size to size. This means that the outside diameter is less than for other types of pipe and in installing this type of pipe in a floating line it is necessary to provide a small bead at each end of the pipe, the outside diameter of which will be the same as the outside diameter of lap welded steel pipe, so that the sleeves will fit over the bead and be clamped to the pipe behind the bead.

3—A standard lap welded steel pipe may be used and gives fairly long service for its cost, and usually the excessive weight is not objectionable as it only means slightly greater displacement for each pontoon but not added labor in moving the pipe line about.

4—In the sizes from 12 inches up there is a high steel carbon pipe which is available, which has been used sufficiently to demonstrate its advantages in light weight and long service. Below 12 inches, this pipe is not so satisfactory on account of the greater difficulty in getting a round pipe and successfully welding it.

5—A rolled manganese pipe made up in sections, each section consisting of one or more lengths 6 feet long, each 6 feet to consist of two sheets each forming a half cylinder and electrically welded into a cylinder. The cylinders are then joined with a butt strip on the outside and electrically welded. This pipe can be made up in light gauges and should have a very long life. It has not been sufficiently used so that dredge men can make any recommendations based on experience.

The several different forms in which dredge pipe can be used are shown in one of the illustrations, the simplest form being that with the bead on each end or the plain pipe to take the rubber sleeves. This can be varied by having the long piece of the pipe flanged and a reverse flange attached to a


Types Of Discharge Pipe
Std. Lap Welded Steel Pipe
Spiral Pipe With Bead
Lap Welded Steel Pipe With Flanges
Nipple & Flange
Lap Welded Steel Pipe One End Flanged - Other End Plain
Slip Or Shore Pipe

nipple used for making the flexible sleeve connection. The third arrangement, where it is desired to have fewer sleeves than the usual length of pipe would allow, is to have each length of pipe flanged on one end so that two pieces are flanged together with a sleeve on the other end of each.

Discharge Pipe Joints

The discharge pipe of a hydraulic dredge consists of floating or pontoon pipe and short pipe. The floating pipe is supported in sections on pontoons with flexible connections in the pipe between the pontoons so as to allow of swinging the pipe into any desired position and also to take care of vertical movements of the pipe line due to wave action.

The only connection between the two units of the pipe line is the pipe joint itself, which joint must transmit a strain lengthwise of the pipe line, be flexible in all directions, and at the same time must be water tight under pressures, which may reach in the neighborhood of 100 pounds or more, but which in normal operations do not exceed about 75 pounds and, of course, on numerous operations it does not exceed 50 pounds.

The first part of the pipe line is under greater pressure than the part nearer the discharge and it so happens that in most jobs the floating line is next to the dredge so that the necessity for joints to remain water tight under the heavier pressures is confined mostly to the floating pipe line.

The cheaper forms of flexible joints are rubber sleeves, although at times leather has been used in this connection. The rubber sleeves are made up

These two illustrations show the operations of Vincent Schiavi of Buffalo, New York. The upper view shows the pipe line running to the shore 1,000 feet back of the booster pump. The lower view shows the lake with the booster pump and power house in the foreground with the dredge in the background. The dredge is a 12 inch electric driven Morris hydraulic unit with a 300 h.p. variable speed motor using 200 volts d.c.

The lake is 3,200 feet long and 700 feet wide. At the present time the pipe line extends over 4,000 feet. The length of the pipe line from the dredge to the spillway at the farthest point will eventually be 6,400 feet. Naylor spiral pipe is used exclusively.

in short lengths long enough to take the circular clamps which clamp the sleeve to the pipe and leaving sufficient room for flexibility between the two pipe ends. These sleeves are subjected to bending and internal pressure and it has been found that longer life is obtained from the rubber sleeves if they are reinforced on the outside by a rope netting which often is made on the job. This relieves the sleeve itself to some extent from the stress due to the interior pressure and does not interfere with the flexibility.

The standard rubber dredge sleeve has an inside diameter which will permit of its fitting over a standard lapwelded steel pipe. On some of the larger dredges the sleeve is relieved of any end strain by surrounding the sleeve with a gimbel ring which acts as a universal joint, being attached to one pipe by two arms on the extremities of the vertical diameter of the ring and to the other pipe by two arms on the diameter at right angles to the former diameter. All these connections are made to the pipe itself and not to the pontoon. For the higher pressures some form of metal joint is required which takes the form of a ball joint which is very heavy and very expensive and makes it worth while to design the pipe so as to contain as few of these joints as possible.

Shore Scows

Where a hydraulic dredge is floating on a water surface which is apt to vary in elevation with respect to the land surface on which the shore pipe is to be laid, it is customary to provide a shore scow which receives the pontoon pipe and is provided with a hand hoist and a pair of small shear legs which make it possible to raise and lower the pipe so as to be of a suitable height to join the shore pipe.

This barge is an exaggerated pontoon such as is used in the floating pipe line and does not require constant attention except in the case of work in tide water, in which case an attendant is usually on board at all times during operations.

Shore Pipe

Shore pipe has to be moved about frequently and it is, therefore, important to have it as light as possible, especially in the large diameters. The length of the shore pipe is more or less fixed by the weight, sections being of such a length that they can be handled by two men, four men, six men, or eight men, as the case may be. A pipe with a spiral seam on the outside absorbs the shocks of work handling and so protects the pipe from bumps and dents.

As shore pipe is usually near the discharge end of the discharge pipe and the pressures are, therefore, low, it has been found that a slip joint answers the purpose and this type of joint is, therefore, used almost exclusively. The joint is held close by wires on connecting hooks, which are placed near each end of the pipe sections. By twisting these wires it is possible to make the joint tight. This type of joint admits of the pipe being laid in a fairly sharp curve and it also can be laid over rough ground without grading.

Where pipe has to cross an area which does not permit of pontoon pipe, but is not high and dry so that shore pipe can be used to advantage, it is customary to build a small trestle on which the pipe is laid from the point to which pontoons can be brought successfully to the point where dry land is encountered.

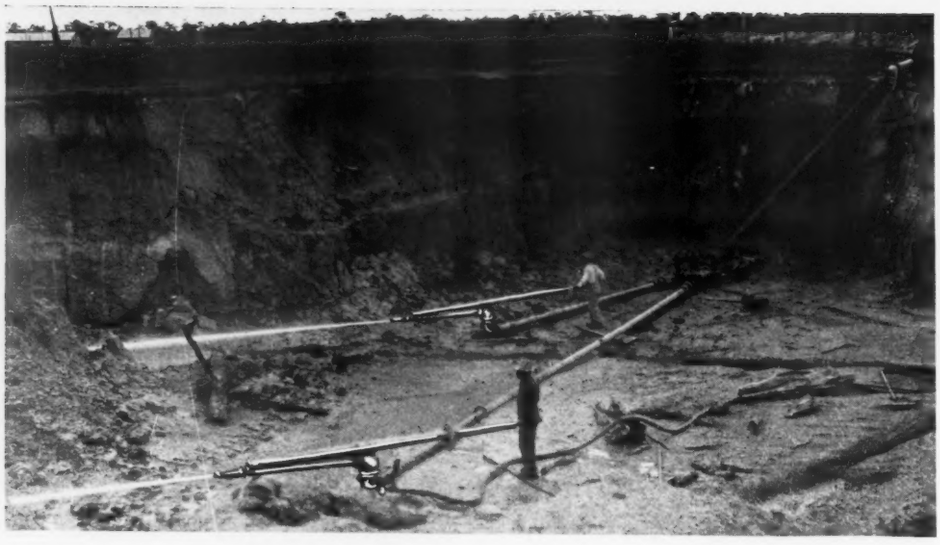
If it is desired to deposit the sand dredged in a long ridge or levee, this can be done by using a shutter pipe, which is a pipe with small square openings in the bottom, which can be opened and closed by means of small sliding doors. As the sand flows along the bottom of the pipe it tends to flow out of these openings while the clear water which occupies the top part of the pipe flows on. In this way most of the sand can be removed from the pipe while a large part of the clear water flows on to a point where it is allowed to find its way back to the general pool. Levees can be built up in this way by carrying the pipe along the center line of the proposed levee on a trestle and allowing sand to build up to the pipe.

The side slopes will be about one on seven unless flash boards are used, in which case a considerably steeper slope can, of course, be constructed. Flash boards are boards which are fastened on edge along the two side slopes so as to retain the sand between them, allowing the water to flow over the top. Where flash boards are used a very large part of the total cost of work is required for moving these flash boards.

Operating Hydraulic Dredges

The method of operating a hydraulic dredge with cutterhead and stern spuds is to line the dredge up along the center line of the proposed cut with the digging spud down and the walking spud up. The dredge is then swung to the corner or edge of the cut and the ladder lowered until the cutterhead is in contact with the material. The cutterhead is then dropped for sufficient additional distance to give the desired depth of cut, which is usually less than half the diameter of the cutterhead. With the cutterhead at this elevation the dredge is pulled across the cut by the swinging line, at a speed which has been decided upon by the designer as being the best for the purpose for which the dredge was built.

Previous to lowering the ladder to contact with the material the dredge pump, of course, has been started and is in operation so that dredging commences as soon as the cutterhead is in contact with the material. The dredge is swung entirely across the cut and then, without lowering the ladder or lowering it a small amount, the dredge is swung



Three Illustrations Showing Hydraulic Stripping and Conveying Operations in the Florida Phosphate Fields

back to the original starting point, the cutterhead lowered for another cut, and the operation of swinging across and back is repeated until the desired depth has been reached.

The ladder is then raised and the dredge swung to such a position that the walking spud when dropped will be a distance forward of the digging spud, which will represent half of the distance it is desired to move up or, in other words, the width of the cut it is desired to dig, which usually corresponds to slightly less than the cutterhead itself.

The operation in moving up, therefore, is to swing the dredge—drop the walking spud—raise the digging spud—swing the dredge sufficiently so that the digging spud when dropped will be on the axis of the cut and a distance forward of its former position representing the width of the cut to be taken—the walking spud is then raised—the dredge swings to the corner and the new cut is started. Most of the digging is done on the swing on which the cutterhead blades are digging upward through the material being excavated. In other words, looking forward from the dredge a clockwise rotation of cutter would be most effective when swinging from right to left.

It is customary to pump clear water long enough so as to fill entirely the discharge pipe before commencing dredging operations and it is also desirable after dredging operations have been completed to raise the cutterhead from the material and pump long enough to clear the pipe line of solids and leave it filled with clear water only. Where several parallel cuts are made each cut subsequent to the first should be made in such a way that the effective digging swing would be away from the former cut, which would tend to prevent the cutterhead from sweeping material into the previously dredged channel.

Booster Pumps

Where the length of the discharge line, together with the static head, is so great that the pump on the dredge will not handle it, it is customary to provide a booster pump in the line which is a centrifugal dredging pump, usually the duplicate of the one on the dredge, excepting that it is usually located in such a place that the power required is not so great as on the dredge.

Most of these booster pumps are driven direct by electric motors and it is desirable that the speed of these motors be variable so as to adapt the speeds of the booster pump to the pump on the dredge in such a way as to divide the work between them in the best way.

Sometimes two or more boosters are used in the line, in which case it becomes desirable to have outlets from the discharge pipe so that a sudden stoppage of one of the booster pumps for any cause will not clog the pipe.

Other Types of Dredges

In addition to the hydraulic dredge there are other dredges which are used sometimes for excavating sand and gravel. These dredges are the clamshell dredge, the dipper dredge, and the ladder or bucket dredge. The clamshell dredge and dipper dredge are very little used and have no peculiar advantages.

The ladder or bucket dredge, however, has some very marked advantages for excavating sand and gravel where the entire washing and handling equipment is on the dredge itself, as this means that the material is excavated by the dredge and not transported. For excavating only, there is no machinery which will do the work better or cheaper than the ladder dredge, as has been proved beyond any shadow of doubt in the placer fields.

These dredges dig to a predetermined depth and clean up the bottom, and the material is carried up in the buckets to a central high point on the dredge from which it descends by gravity through the various processes to barges which can be moored alongside of the dredge.

With the bucket dredge the supply is fixed and steady and, therefore, adapts itself to the screens and other equipment without the necessity of any regulating device. A number of these ladder dredges are in use in river recovery of sand and gravel and for this purpose there is no question of their supremacy in operating cost and convenience.

These dredges are usually driven by the Diesel engine and with large fuel tanks they are independent of shore and can work anywhere in the river irrespective of the location of the navigable channel. There is no doubt but that more of these dredges will be used and if carefully designed will prove to be very satisfactory equipment.

Dredging Pumps

Dredging pumps are all centrifugal pumps with horizontal shafts and all of them are single suction except a few in use on the dredges of the Mississippi River Commission. Usually the discharge is led out horizontally from the bottom of the pump. The hydraulic efficiency approximates fifty per cent. This low efficiency, in comparison with pumps for clear water, is due to the large passages and the clearances, which cannot be as small as they should be on account of the gritty material being pumped.

The principal features of a good dredging pump are resistance to abrasion, large open passage way for the water, and a design permitting of a removal of a part of the casing at a time. Pump shells and runners, or impellers, are of cast iron, open hearth or manganese steel or crucible steel and combinations of cast iron or open hearth steel casing and manganese steel liners. Cast iron pumps have very thick shells which, when worn through, can

be replaced at a low cost. Thousands of these dredging pumps are in use today handling abrasive material, notably in Florida in the pebble phosphate fields, where practically all of the matrix, containing the phosphate, is pumped by them.

A heavy duty dredge pump, in addition to resistance to abrasion, should have a long main bearing which can support the overhung shaft and runner without any assistance from the outboard bearing, which is present in belted pumps, but entirely absent in pumps which are direct-connected by a flexible coupling to an electric motor or engine. This calls for a very long main bearing with most effective lubricating arrangements and an adequate thrust bearing to counteract the partial vacuum which exists in the eye of the pump and which pulls the runner toward the suction side of the pump. The pump casing is usually divided into the shell, with the discharge opening, the front head with the suction opening, and the back head with the stuffing box for the shaft.

Dredging pumps may be divided into two classes: First, the commercial pumps which have small diameter impellers and therefore have to be run at high speed so that they can be direct-connected to an electric motor or heavy duty gasoline engine; and second, the pumps which are made to order with large impellers of sufficient diameter to admit of low speed and therefore direct-connecting to a steam engine or an oil engine. The commercial pumps can be driven by steam or oil engines through some reduction gear such as a belt, a silent chain, rope drive or spur gear reduction unit.

Power Required for Pumping

The power required on a hydraulic dredge for the operation of the dredging pump is calculated from the water horsepower, which consists of the volume of water handled in cubic feet per minute multiplied by weight per cubic foot of the mixture of water and solids, which gives the total weight of material handled per minute and which, if multiplied by the total head in feet against which the pump has to work, gives the foot pounds per minute, which divided by 33,000 gives the water horsepower for the pump.

As the pump has an efficiency of about 50 per cent the brake horsepower would be twice the water horsepower. The total head against which the pump works is made up of the suction head, velocity head, the static head and the friction head.

The suction head is represented by the vacuum in inches on the gauge attached to the suction pipe and represents resistance to flow caused by the friction in the suction pipe and also to the loss of head at the entrance of the pipe where the water

Cleaning Face of Quarry and Stone Already Broken Up

changes from rest to the velocity of 10 or 12 feet per second, and, if the suction pipe is partly obstructed by material, the velocity of the flow may be very much higher.

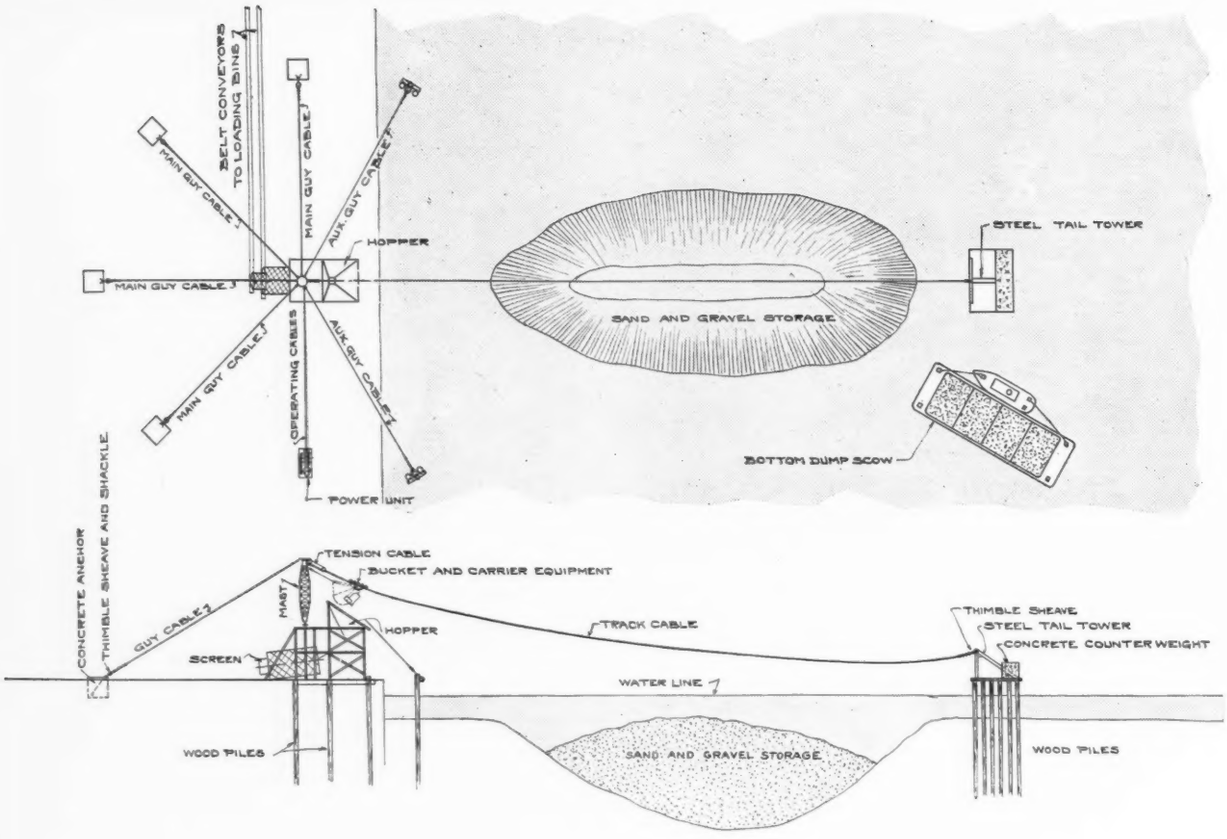
As 30 inches of mercury is the equivalent of 34 feet of water it shows that by increasing slightly more than 10 per cent the number of inches shown on the vacuum gauge, the loss of head in the suction pipe as far as the pump can be expressed in feet of head.

The loss of head due to the velocity of water can be put down at 2 feet. The static head is the actual elevation of the end of the discharge pipe above the level of the water at the dredge. The discharge pipe may reach a higher elevation than the discharge end, but if the pipe is air tight the static head will not be increased provided the discharge pipe was flowing full, but if it is flowing only partly full the static head must be taken at the point where the pipe ceases to run full. By discharging under water it is often possible to eliminate the static head entirely in dredging.

The friction head is stated in one of the tables and is for clear water only and does not include bends, sleeves or the additional loss of head caused by pumping solids instead of clear water. The action of the solids in the pipes is such as to reduce the effective cross section of the pipe, as the material settles and runs along the bottom one-third of the periphery of the pipe at a much smaller velocity than the water. This results in a higher velocity of the water itself than would be the case if the whole area of the pipe were available, and the increase in velocity, of course, means increased friction, which is provided for in the calculations by adding a suitable percentage to the friction head for clear water.

All centrifugal pumps will pump more water as the discharge pressure or head is reduced, and in most centrifugal pumps the horsepower increases as the head is reduced and the flow is increased. In other words, a hydraulic dredge pumping over the stern would probably require more horsepower than at any time with a pipe line installed, so that under those conditions it would mean, if the pipe line were broken in two, an overload is thrown on the prime mover, which makes it advisable, in the case of the electric motor, to install a motor which is able to take care of the pump under these conditions.

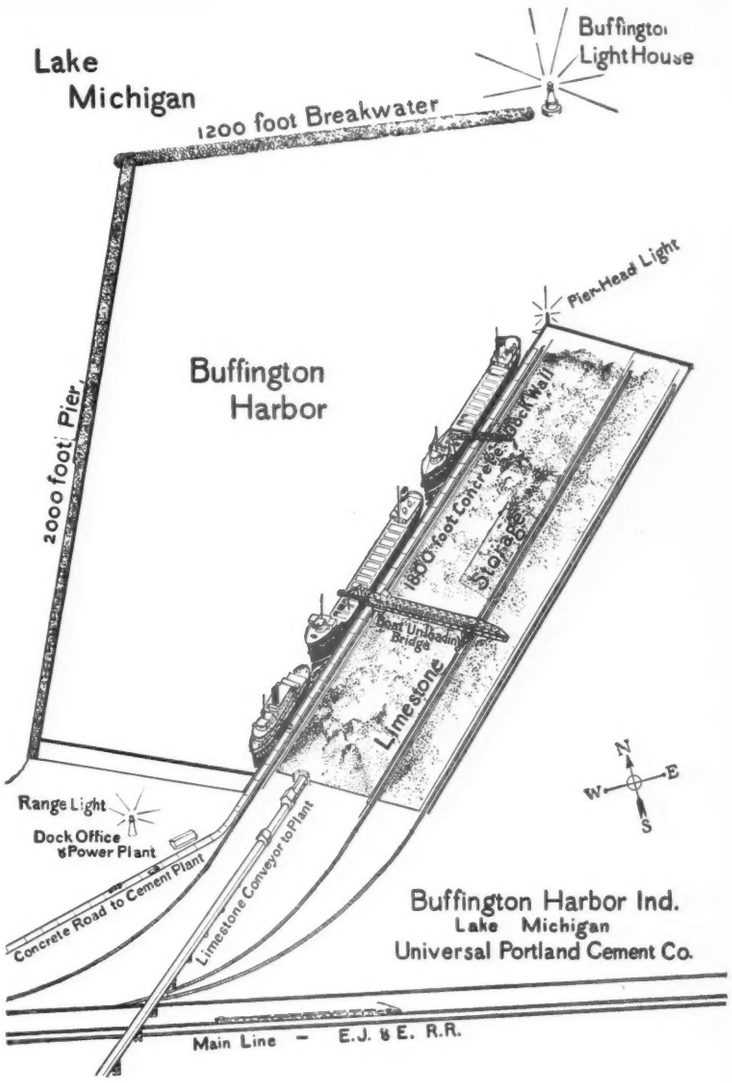
An Example of the Large Freighters Being Used To Transport Pit and Quarry Materials on the Great Lakes



The above two pictures illustrate an efficient method of reclaiming material from under water storage. The layout is a combination of a floating dredge and cableway for working a large pit. The front of the pit serves as a dump to receive the discharge from the pipe line and the cableway raises the material tothescreens. The cableway handles five tons each trip and makes a round trip every minute. In this particular installation three thousand tons of material are handled each day by one man.

A new transportation era was inaugurated in the Pit and Quarry Industry this year with the formal opening to navigation of the new Buffington, Indiana Harbor of the Universal Portland Cement Company.

This substantial waterway improvement includes use of the largest fleet of freighters on the Great Lakes, with self-unloading craft that automatically discharge their huge cargoes at a ton a second, the largest movable boat-unloading bridge in the Chicago district for unloading standard steamers, a million-ton storage yard, a mile-long belt conveyor carrying material from dock to cement plant at the rate of six tons per minute, an 1,800-foot concrete dock wall, 600 feet wide, that provides facilities at the same time for unloading limestone and loading cement for shipment, a 2,000-foot massive breakwater and an all-concrete lighthouse with an electric beacon visible 13 miles away.



Pump Drive

The principal recent development in hydraulic dredges has been in the method of driving the dredging pump. In early days most of the pumps were driven by steam engines which were direct connected to the pump and which, on account of their low revolutions per minute in the larger sizes, required a specially built pump with large diameter impeller and shell.

As electric motors came to be used more and more for direct connection to centrifugal pumps, the pump impellers and shells were reduced in size to accommodate the higher speeds of the electric motors and these smaller diameter pumps came to be a commercial standard.

Where the steam engine speeds had been from 200 to 400 r.p.m., the electric motor speeds varied between about 435 r.p.m. and 870 r.p.m. The heavy duty gasoline engine with its speeds from 900 to 1,500 r.p.m. required still smaller impellers for direct connection. The heavy oil engines were available, of course, but with speeds varying between 250 and 400 r.p.m.; or in other words, they covered about the same range as the steam engine, so that it was necessary to use them with specially designed large diameter pumps or else use some type of speed increaser in order to make use of the commercial pump.

These speed increasers consisted, first, of a leather or canvas belt; second, a rope drive; third, a silent chain drive; fourth, a spur gear speed reduction unit. At the present time there is also available the Texrope drive.

Heavy oil engines of the full Diesel type are now obtainable at higher speeds and as time goes on more and more engines will be available at speeds which will compare with the electric motor speeds, namely, from 435 to 870 r.p.m., so that the same diameter pump which can be used with an electric motor can also be used for direct driving by a Diesel engine.

The vertical multi-cylinder high speed Diesel engine with a commercial size of centrifugal dredging pump coupled direct to the engine shaft

The illustration at the left shows a scraper in one of the tunnels in the bottom hold of a self unloading freighter. This scraper is an eight yard unit and holds 10 tons of stone or 6 tons of coal. It has an average unloading capacity of 700 tons per hour. The scraper is operated by a double drum steam hoist placed at the forward end of the ship. The speed of the scraper is from 200 to 250 feet per minute and the mazimum back haul speed is from 400 to 500 feet per minute. The power drag scraper dumps into a hopper that feeds a system of conveyors leading from the hopper to the shore piles. The roof of the tunnels are self cleaning. The space between tunnels and sides of the cargo space are hoppered so that the entire boat is self clearing.

through a flexible coupling forms a dredging unit which possesses to a remarkable degree the qualities of lightness, compactness and low operating cost and forms the ideal unit in all cases except those where a dredge is to operate continuously in one spot with cheap electric current. With a steam engine the fuel has to be handled in large quantities until it reaches the dredge to be burned under the boilers. The electric dredge requires a cable connection with the shore, which is always a nuisance.

The Diesel engine dredge requires a supply of fuel, but the consumption is so small compared with the burning of oil under boilers that tanks may easily be provided on the dredge so that with the tanks filled up the dredge can operate for days at a time independently of the source of fuel supply.

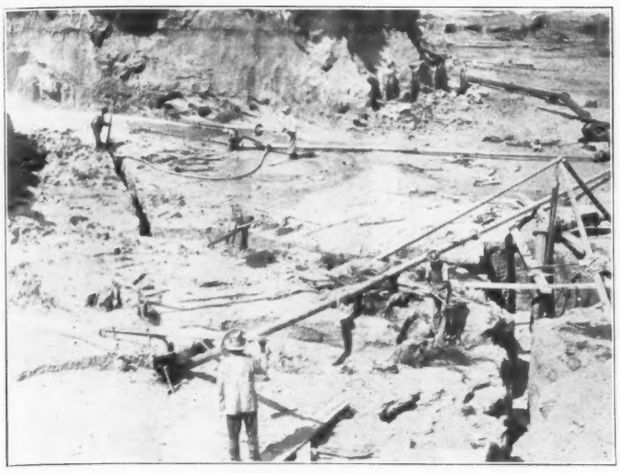
It is advisable, in direct connecting a centrifugal dredging pump, to provide a high grade flexible coupling which will eliminate any of the troubles due to poor alignment of the shafts or distortion of the foundation. It is also desirable to have the flexible coupling of such a design that, if the pump is stopped suddenly by an obstruction inside of it, the engine may be stopped without sudden shock. This means that pins should be arranged in the coupling for shearing, or friction surfaces be provided which are inadequate for the purpose when the driven member is stopped suddenly.

The electric magnetic clutch is ideal for this purpose as it enables the engine to be started without turning over the pump, it gives the necessary flexibility and it permits the engine to revolve without shock when the pump is stopped suddenly by an obstruction. In place of the electric clutch various forms of friction clutch can be installed which not only furnish somewhat flexible connection between the two shafts, but also permit of the engine being started without turning over the pump and of slipping in case of sudden stopping.

Priming Centrifugal Pumps

The usual method of priming a centrifugal pump is to close the flat valve in the discharge pipe, lower the mouth of the suction pipe so that it is under water and then exhaust the air from the suction pipe and the pump shell by means of an ejector operated by compressed air or by a jet of water under pressure. The top of the pump shell should be the highest point in the space to be exhausted so that the ejector placed on the top of the pump will be able to reach all of the air in the space.

On some of the small dredges it is necessary to operate the dredging pump while the priming is going on, and in this case the air exhauster should be in the eye of the pump, as this is the location of the final volume of air in the exhausting process, the shell of the pump being filled with water by



Typical Overburden Pit in Operation in Florida

centrifugal force, forcing the air into the middle of the pump.

While a centrifugal dredging pump is in operation clear water has to be introduced into the stuffing box around the shaft with sufficient pressure so as to flow from the stuffing box to the pump and thereby prevent any flow from inside the pump into the stuffing box, which would mean gritty water and a scored shaft within a very short time. This is a very important matter and it is desirable to have a gauge in the pressure line near the pump or where the operator can see it at all times so as to be sure that the pressure is being maintained.

Hydraulic Method of Handling Material

It is often possible to make use of the hydraulic transportation of excavated material in combination with the hydraulic removal of the material from its original position by means of a high pressure jet of water. This system was first used to a large extent in the states bordering on the west coast of the United States where pressure water could be obtained simply by ditching and piping the water from mountain streams. The system was used for cutting down gravel banks so as to be able to wash out the gold and tremendous quantities of material were handled at a very low cost.

This same system has also been used in Florida with the exception that there are no mountain streams; therefore, the pressure water is supplied by centrifugal pumps. Even with the necessity of supplying power for the pressure pumps the system has proven to be highly economical. In Florida it is used for stripping and also for mining the conglomerate containing the phosphate pebbles.

Up to the last five or six years the same system has been used in the Malay States for working the inland deposits of tin, in some cases pressure water being available and in other cases having to be pumped. The system is now largely in use for building hydraulic-fill dams in various parts of the world.

A complete system consists of the large nozzles or monitors for delivering the high pressure jet against the bank to be excavated, and the material after being excavated runs down to a sump by gravity, from which point it is pumped to the desired location by means of a centrifugal dredging pump.

In California, in the early days, instead of using a centrifugal pump for disposing of the excavated material a device known as a hydraulic elevator was installed and this device elevated the material by means of more pressure water supplied at the lower end of the elevator through a jet which was directed on the mixture of water and excavated material as it passed through a constricted manganese throat. The hydraulic elevator is extremely inefficient, being not over 25 per cent or about half the efficiency of a centrifugal dredging pump. The only excuse for their use was the inexhaustible supply of pressure water available.

The writer has made use of this device for pumping sand a distance of 400 feet in a river channel where only 20,000 cubic yards of material had to be handled and no power was available except pressure water from the nearby pumping station. This work cost less doing it this way, and was completed in half the time that it would take to do the work with a centrifugal pump.

As a standard method of operation on a large scale the hydraulic elevator is probably the least efficient method which could be employed, which explains sufficiently the rare use made of the device. In the Florida pebble phosphate field the hydraulic method is being more and more replaced by dragline machines for the stripping only, as it has been found to be cheaper to overcast the overburden with a large dragline than to pump the stripping away and stack it up at some distance. The hydraulic method, however, is still being used, and almost exclusively used, for the mining of the phosphate.

The phosphate pebbles are recovered from a matrix consisting of sandy clay and it is necessary to wash this material so as to separate entirely the matrix from the pebbles. It has been found that the handling of this material by monitors and by centrifugal pumps greatly reduces the amount of washing subsequently required. There is a certain advantage, of course, in this method in handling sand and gravel for concrete purposes.

The method has also been used in stone quarries for removing the overburden and also for working over old spoil piles which have to be removed and which contain large percentages of useful rock requiring only separation from the rest of the overburden to be ready for the crushers.

Different classes of material require different diameters and pressure of the jet and after these are established the equipment is installed sufficient

for operating one nozzle or more as required. The pressure water is used over and over again by being allowed to settle in a sufficiently large area of basin so that it can be handled over again with pressure pumps of high efficiency without damage to the pumps from grit. In this way a supply of water once accumulated can be carried along throughout the entire job, with very little required for make-up.

Large diameter spiral pipe is used for conveying the pressure water from the pressure pumps to the immediate vicinity of the nozzle or monitor and smaller pipes are used from that point to the actual monitor location, which is apt to be changed frequently. Even these terminal pipes should be as large diameter as can be handled conveniently, as rapid velocity in these pressure lines cuts down the available pressure at the nozzle and means that effort expended in the pumps is wasted in the pipe.

It often happens that the easy cutting nature of the material being handled by the monitor gives a greater percentage of solids than the dredging pump can handle successfully. In this case, additional water at just enough pressure to deliver it in the dredging pump sump is supplied to make up the necessary percentage of water in the mixture to be pumped. In the Pit and Quarry Handbook for 1927, useful tables are given on pages 311-315, which should be very helpful in planning on the use of this method of handling material.

If a piece of work is suitable for this method of operation and a suitable plant is installed, it is a very satisfactory method of moving material. The only labor around the job except common labor is the nozzle man and the man in charge of the pumps. The rest of the labor is used simply for handling pipe lines and moving the monitor, and where working among loose rock they can be used to advantage in cracking the larger rocks in two so that they can be moved with the jet.

What is known as a "one man size rock" can be moved very easily with a high pressure jet and even "two man size rocks" can be handled without much difficulty. The usual operation requires around 1,500 to 3,000 gallons per minute at a pressure between 100 lbs. and 200 lbs. per square inch, and in addition to the volume of water and the pressure of it, it is necessary to acquire considerable experience with the jet in order to make the most efficient use of it. Most jets are from 1½ to 2 inches in diameter, although much larger jets are used and much higher pressures for unusual conditions.

If a large basin is used so that the water comes to the pressure pumps with no grit, the pressure part of the equipment, consisting of the large diameter spiral pipe and the pumps and motors themselves, will show very little deterioration and can be used for years. The same may be said of the monitor, but the dredging pump and the pipe for conveying the material from the dredging pump, of course, will show the usual deterioration caused by abrasion.

Pit & Quarry Made Wonderful Strides Writes Prominent Asphalt Official

H. T. Carmichael, vice-president in charge of production, Kentucky Rock Asphalt Company, writes: "You have made wonderful strides with this publication (Pit and Quarry) and we find it one of the most complete and interesting magazines of its sort on the market today."

Quarry and Cement Men Will Meet at Safety Congress

Both joint and separate meetings of the quarry and cement sections of the National Safety Council will be held when that body meets in annual congress in the Stevens Hotel, Chicago, September 26-30, 1927.

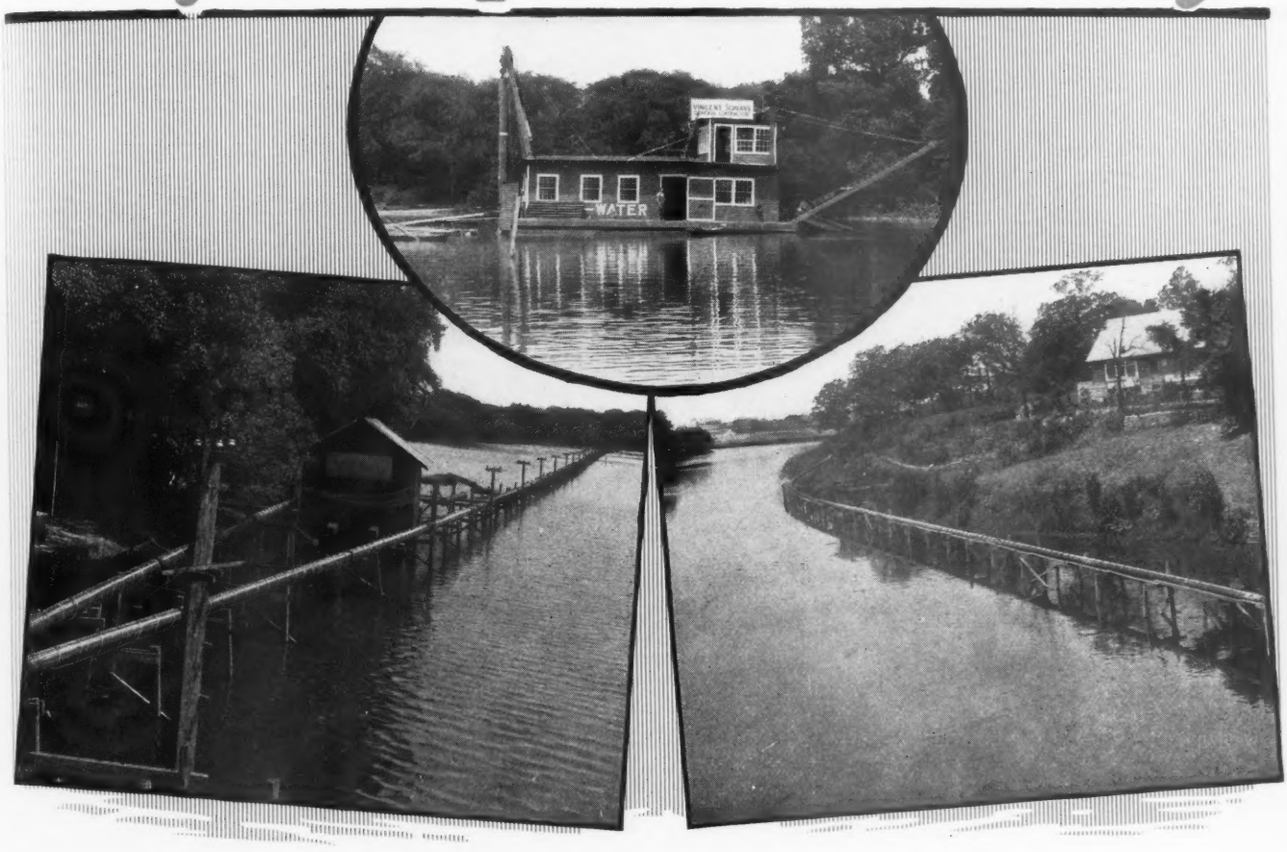
The meeting of the quarry section, which will be held on Wednesday morning, will be addressed by Otto M. Graves, president of the National Crushed Stone Association, on the subject of accident prevention. A. Jones, of the Indiana Lime Stone Company, will speak on "Safe Handling of Rock" and other speakers will discuss such subjects as quarry railroad safety, how to organize a quarry for accident prevention and safe practice in stone mill operation. L. R. Cartwright of the Mid-West Crushed Stone Company is chairman of the section.

The cement section, which will meet on Tuesday morning, will be addressed by J. B. John, president of the Sandusky Cement Company, W. P. Sabin of the Ash Grove Lime and Portland Cement Company and Richard Hardy of the Pennsylvania Dixie Cement Corporation. The joint meeting of the two sections will be held on Tuesday afternoon. W. L. White, Jr., of the Sandusky Cement Company, and W. H. Weitknecht of the Lehigh Portland Cement Company will discuss "Fixing Accident Responsibility." A. R. J. Curtis of the Portland Cement Association will speak on the subject of "Technical Study of Cement Plant Accidents."

Sandy Pratt and His Superintendents Find Pit and Quarry Informative

Clarence (Sandy) F. Pratt, president, Pratt Building Material Company, writes: "I and all the superintendents of our five plants always enjoy Pit and Quarry. Since being published in a larger size it is more interesting and we always find it very informative."

Naylor Pipe *Exclusively*



MORE than a mile of Naylor Spiral Lock-Seam Pipe is used on a large back filling job at the Vincent Schiavi dredging operation, Buffalo, New York.

Their reasons for selecting Naylor Pipe were probably the same as those that prompt many other dredge and hydraulic engineers to specify Naylor:

Large power savings are effected by the smooth inside and the low frictional resistance which allows freer flow of material than in any other light weight steel pipe.

The high carbon steel wearing strip, folded into the seam on the inside, takes the wear of abrasive materials passing over the seam, and materially increases the length of service.

There are no obstructing inside seams or rivets to wear or rust out.

It is light in weight, effecting a real saving in transportation and handling costs.

Naylor Pipe is made galvanized, plain or asphalted, in all diameters from 4 inches to 30 inches, and with plain, flanged, slip joint or pontoon ends.

Large stocks guarantee prompt shipment. Write for a sample section.

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Naylor Spiral Lock-Seam Pipe

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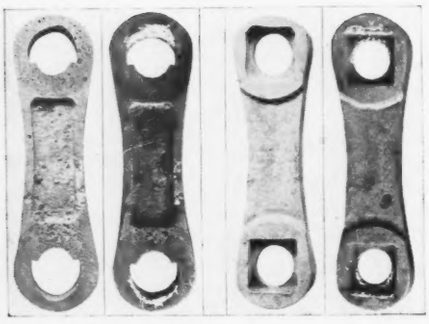
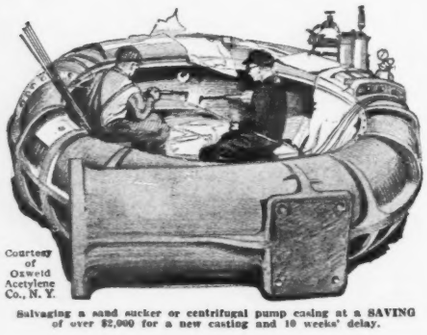


Before After Before After

Reclaiming Chain Links with ROL-MAN Welding Rods



Courtesy of Oxweld Acetylene Co., N. Y.

Salvaging a sand sucker or centrifugal pump casing at a SAVING of over $2,000 for a new casting and 10 weeks' delay.

ROL-MAN Welding Rods

For building up worn surfaces and reclaiming at a saving such parts as Dredge Cutter Heads and Blades, Pump Casings, Runners and Side Plates, Hull Pipe, Conveyor Links, Pins, Bushings, Flights, Buckets, Lips, Gudgeons and Boxes, Crusher Jaws, Concaves, Mantles, Hammers, Liners, Crusher Rolls and Teeth, Dipper Fronts and Teeth, Grab Bucket Lips, etc.

Before the introduction of ROL-MAN High Manganese Steel Welding Rods, the welding of manganese steel was unsuccessful. Today, parts welded or surfaces rebuilt with ROL-MAN Welding Rods are outlasting the original castings. And through the use of ROL-MAN, tough-hard manganese steel wearing surfaces can be built up with equal ease on cast or rolled and forged carbon or alloy steels.

Success follows the use of ROL-MAN Welding Rods in every case where the instructions accompanying them are followed. Descriptive folder on request.

"It isn't the first cost; it's the upkeep"

In few fields is the constant necessity of equipment replacements so frequent as in the non-metallic mineral industries. Constant grinding and abrasion, continued heavy pounding and hammering—no sooner has a piece of equipment been replaced than the destructive forces of wear are at work to tear it down again.

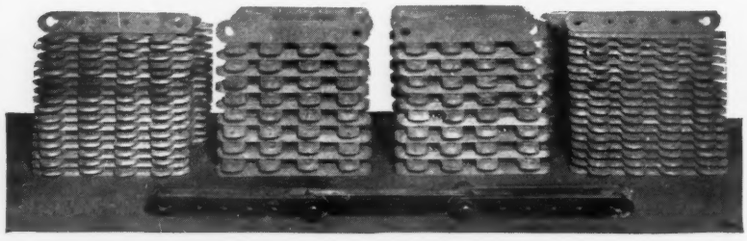
What are you going to do about it?

You can continue as in the past to patiently replace with the same material. But it isn't necessary, and *it's costing you money.* Don't forget, ... "it's the upkeep" that eats up your profits.

It may seem almost unbelievable to you that the more impact and wear you exert upon ROL-MAN Rolled Manganese Steel the better it wears. But it's a fact—and has been demonstrated time and again in your own and similar industries.

ROL-MAN Rolled Manganese Steel possesses 2½ times the strength and toughness and 10 times the wear-resisting qualities of commercial carbon steel. Toughens and hardens under use. Will not crack or break when exposed to severe impacts and shock. Saves real money in the cost of replacements alone and minimizes loss occasioned by too-frequent shut-downs for repairs and renewals and lost production.

You can use ROL-MAN Manganese Steel in many places with profit. A few applications are described here. More detailed information will be gladly sent upon request.



ROL-MAN Flat Link Dredge Chain

ROL-MAN Rolled Manganese Steel Flat Link Dredge Chain in use on a large Ohio River dredge. 100 ft. centers, double strand, 24 in. pitch. Center links 1½ in. thick, 4 ins. wide, 30 ins. long, 1 13/16 in. plain pin holes. Side links ¾ in. thick, 4 ins. wide, 30 ins. long, 1 13/16 in. keyed pin holes. Weight 4½ tons.

Highest Abrasive Resistance
Maximum Wear Life

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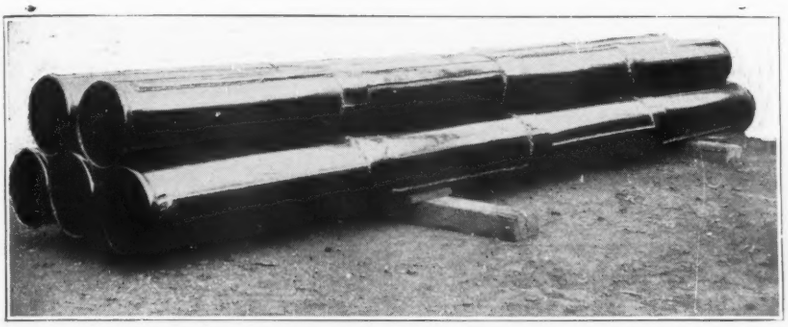
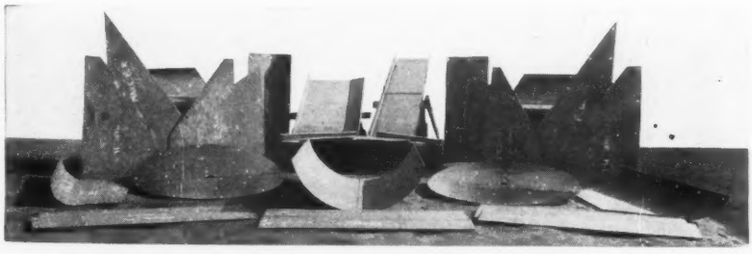


ROL-MAN Screens

10 to 30 times longer life and 30% to 50% greater production than ordinary perforated plate and woven wire screens. These are not estimates, but actual records being made by ROL-MAN Double Lock Mesh Woven Manganese Steel Screens in a number of plants in your field. And in addition, most producers who have used them comment enthusiastically upon the greatly improved accuracy of sizing of materials graded with ROL-MAN Screens.

BETTER SCREENING AT LOWER COST is the title of the booklet which contains proof of the additional profit to be had with ROL-MAN Screens. If you have not yet secured your copy we urge you to send for it at once.



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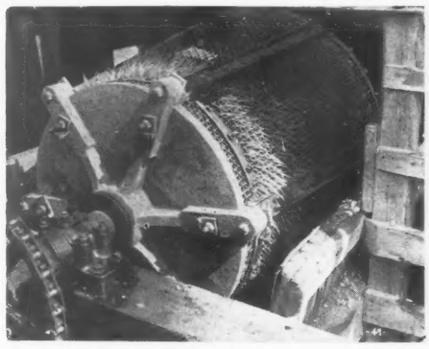
The rush of abrasive materials mixed with water under heavy pressure spells a hard life for all pipe in this type of service. But enormous savings in replacements can be made and shut-down losses avoided through the use of ROL-MAN Welded Manganese Steel Pipe. ROL-MAN'S peculiar property of toughening and hardening—actually improving—under severe impact and abrasion stands you in good stead here.
A trial length of ROL-MAN Pipe will convince you that it's what you need and want. Rough sketch or drawing of your standard length will bring a prompt reply with further information and quotation.



ROL-MAN Chutes, Liners and Wear Plates

ROL-MAN Plates have made an enviable name for themselves with many producers of abrasive materials. They afford an ideal combination of extreme hardness with great toughness and strength—the qualities most sought for in the service to which they are particularly suited. Here again ROL-MAN offers you for the first time a true, tough-hard manganese steel in thicknesses under ½ inch. ROL-MAN Plates in smaller thicknesses will several times out-wear the material you've been accustomed to use in twice the thickness. Ease of handling, due to lighter weight, as well as superior wearing qualities, recommends their use to you.
Furnished in any thickness from ⅛" to ½", sheared to size, flat or rolled to radius, flanged, bent, punched, countersunk and fabricated to specifications. Quick shipments at all times from our large stock of all sizes.

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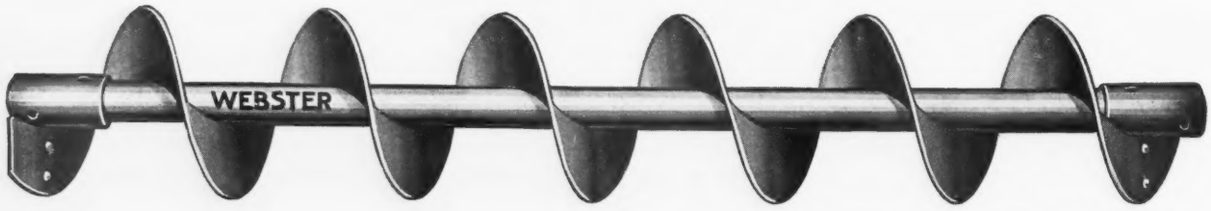

SECTIONAL FLIGHTS CUT FROM PLATE STEEL AND ROLLED TO FORM. UNIFORM IN THICKNESS FROM CENTER TO EDGE—THE GREATEST WEAR IS ON OUTSIDE EDGE. END FLIGHTS WHERE HEAVIEST DUTY IS PERFORMED ARE HEAVIER. DAMAGED FLIGHTS READILY REMOVED AND NEW FLIGHTS INSERTED.

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STEEL AND MALLEABLE IRON BUCKETS IN ALL SIZES AND STYLES

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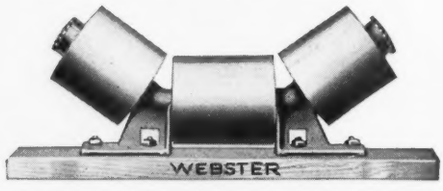

SEVERAL TYPES BELT CONVEYOR IDLERS FITTED WITH PLAIN, BALL OR ROLLER BEARINGS

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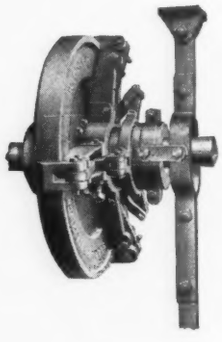

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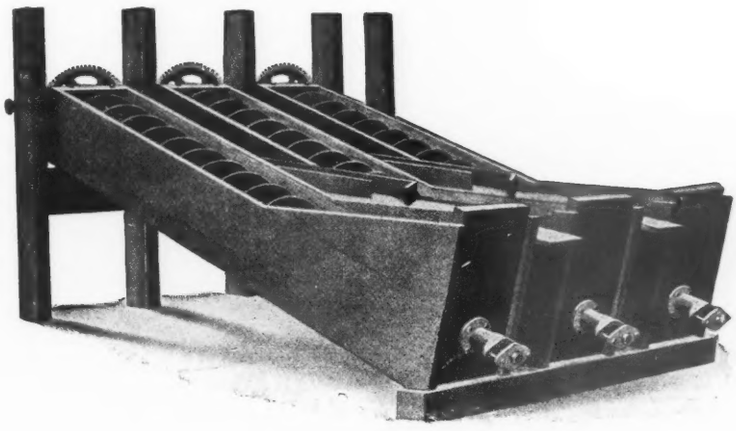
WEBSTER-BRINKLEY CO., SEATTLE WEBSTER-INGLIS LTD., TORONTO

18 Lewistown Sand Washers Installed by Hainesport



YOU cannot help but be impressed by the fact that the Hainesport Mining & Transport Co., said to be the largest Hydraulic plant in the country has had 16 Lewistown Sand Washers installed at Morrisville, Pa., and 2 at their Van Scivers plant.

Here is a company whose demands called for thoroughly washed sand and they have, in installing 18 Lewistowns, expressed the utmost confidence in this machine to do the work.

Lewistown Sand Washers are reasonably priced, well built and compact outfits. They are highly efficient and quickly installed.

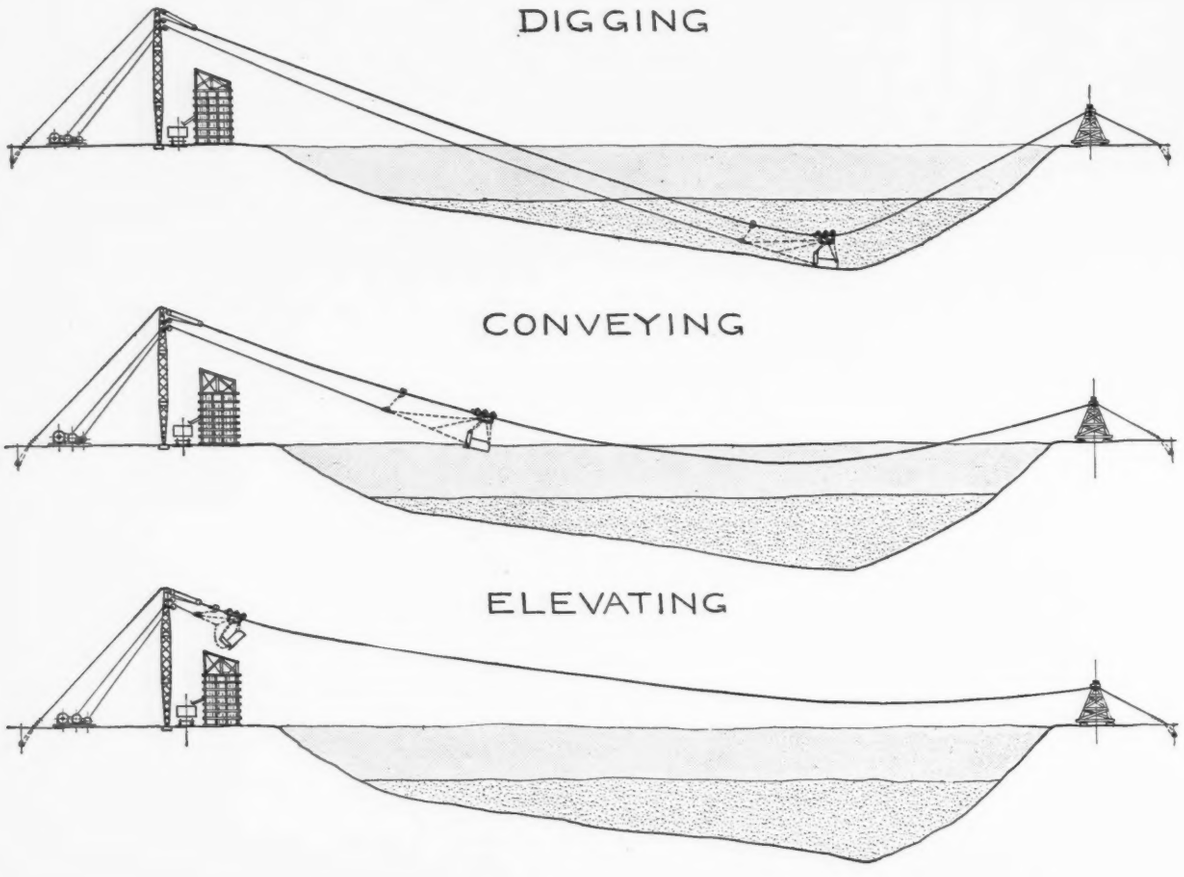
The Lewistown Sand Washer will solve your problem as it did that of the Hainesport Co.

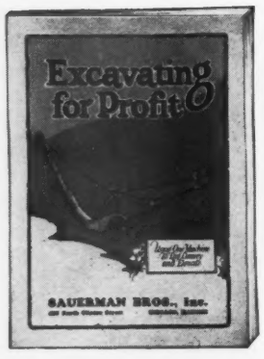
Write today for full information.

Lewistown Fdy. & Machine Co.

Lewistown, Penn.

How a Sauerman Slackline Cableway Reduces the Cost of Producing Gravel





Here is a 48-page book filled with useful information for everybody who has excavating problems to solve. Contains records of slackline cableway performance under difficult conditions that will thoroughly arouse your interest in the Sauerman system of excavating and moving materials. Illustrated with over 100 photographs and layout sketches. A copy of this book, "Excavating for Profit," is yours for the asking. Send for it today.

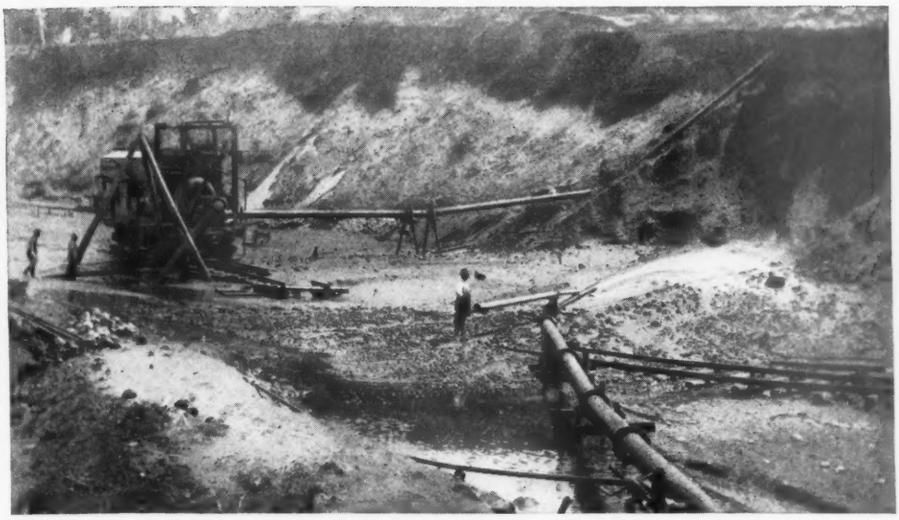
IN THE above sketches you see a Sauerman Slackline Cableway reaching out across a wide river or pit, digging material that lies 100 ft. under water, and lifting this material to the top of a high screening plant.

Despite its apparent hugeness, this machine is economical in first cost. And it is particularly easy to operate. All the operator has to do is handle the levers of the smooth-running Sauerman 2-speed power unit and watch the bucket travel back and forth all day long at the rate of 40 to 50 round trips per hour. A single pay envelope represents the entire labor cost of moving the sand and gravel from the pit to the screens.

There is a size of Sauerman Slackline Cableway to take care of every capacity requirement in the sand and gravel industry, from the local plant with a limited market all the way up the scale to the producer who ships thousands of tons per day. Standard Sauerman excavating buckets range from ¼ to 3½ cu. yd. in size, and larger sizes are built to order.

Write us about your particular proposition. Whether you are interested in digging from a river bar, from a dry pit, from a high bank or from a deep under-water deposit, we can offer an equipment layout that will meet your particular conditions and produce whatever daily yardage you require at minimum cost.

SAUERMAN BROS., Inc., 434 South Clinton Street, CHICAGO



The ideal pipe for dredging and hydraulicking

FOR OVER A QUARTER OF A CENTURY the superior strength, light weight and low cost of Taylor Spiral Riveted Pressure Pipe has made it the first choice for dredging, mining and sluicing. Its extreme rigidity, the ease with which it may be transported and installed, its unbreakable forged steel flanges and its unusual durability are profit making features which are well known to hydraulic engineers everywhere.

Made of special steel for long life, it may be supplied heavily galvanized or with a hot dipped asphalt coating inside and out. It is available in all diameters from 3 to 42 inches and in lengths up to 40 feet. Every length is hydraulically tested to fifty per cent more than specified working pressure and its spiral construction makes it fifty per cent stronger than any other riveted pipe.

A large catalog containing much valuable data and many interesting installation pictures will be mailed to you on request.

Note these Advantages:

(1) The riveted spiral seam for greater strength and stiffness. Riveting is by compression under enormous pressure — not by hammering.

(2) The forged steel flange — practically unbreakable. It can be more securely attached to the pipe, eliminating leakage. It cannot be broken in shipment, during installation or in service.

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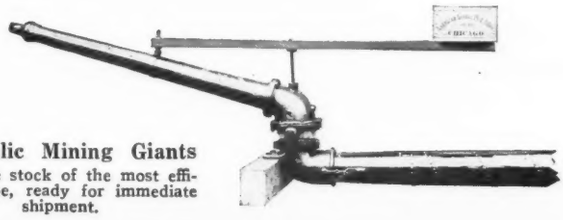
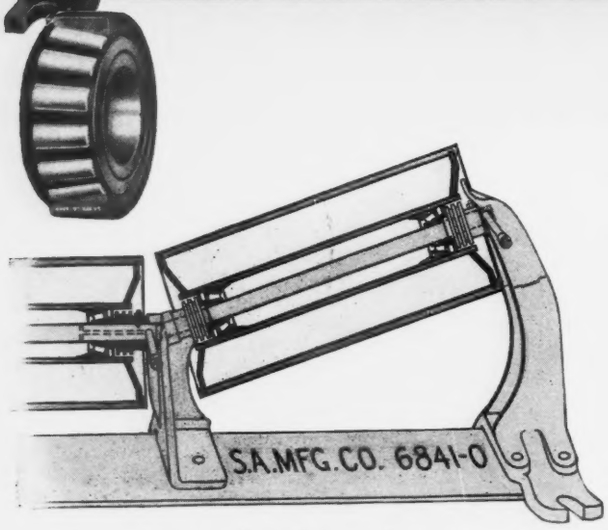


Hydraulic Mining Giants
Complete stock of the most efficient type, ready for immediate shipment.

P & Q 8-17 Gray

Simplicity of design and Timken bearings feature the S-A "Simplex Carrier"



Cross section shows pulley construction and bearing mounting of S-A Simplex Conveyor Carrier. The Simplex is designed for belt conveyors from 18 to 60 inches wide.

The "Simplex" is another notable S-A design in belt conveyor carriers. With a minimum number of parts, all-steel pulleys with seamless drawn steel ends, each pulley is well balanced and practically unbreakable. There are no sharp edges to fray belt and carrier tilts slightly to help train the belt.

Two Timken roller bearings, high-pressure lubricated, are mounted in each pulley in dust and grit-proof housing. End castings are designed to protect bearings from belt dribble.

Write for bulletin No. 16 which describes the features of the Simplex Carrier.

Stephens-Adamson Mfg. Co.
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Los Angeles, Calif. **Belleville, Ont., Canada**
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STEPHENS-ADAMSON
S-A BELT CONVEYORS

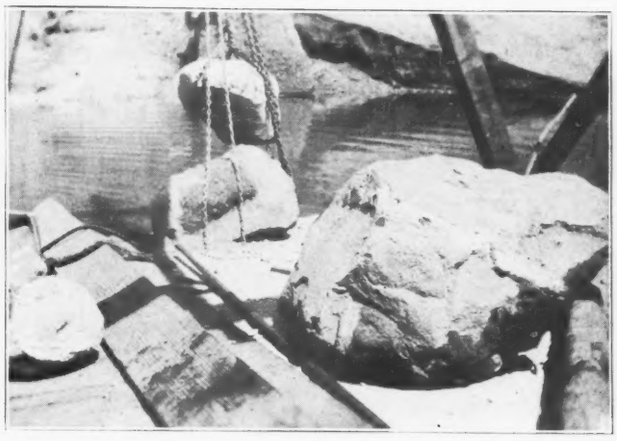
WARD SAND AND GRAVEL COMPANY SUCCEEDS WITHOUT APPROVED DREDGING METHODS

By H. W. Munday

DURING the winter and spring of this year, the Ward Sand and Gravel Company has made several radical changes in the method and equipment of the plant at Oxford, Michigan. This company operates the largest and most unusual operation in the entire commercial sand and gravel industry. An average of 600 tons of sand and gravel are produced per hour with methods not approved by engineers but which in fact have been successfully employed by the Ward Sand and Gravel Company for the past two years.

The changes made during the past winter and spring have to do with the method of loading and storing material between the dredge and the crushing, screening and storage plant. The manufacturing unit has been practically doubled throughout. The excavating unit has been enlarged so that stone up to 15 inches in diameter can be handled without delay. Barges are used to give storage between the excavating and manufacturing units of the plant. Belt traveling screens that handle the maximum load at all times have been installed. The plant has been separated into three units, that is, the excavating unit, the loading and transportation unit and the manufacturing unit.

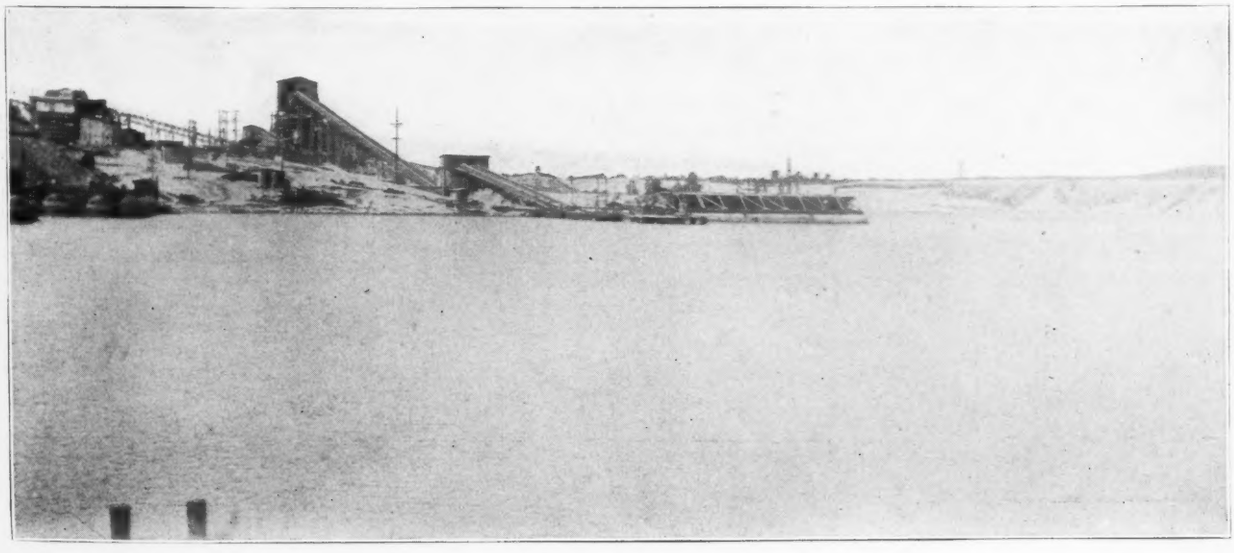
During 1925 and 1926 the efforts of the management were directed towards increasing the plant capacity, which has been developed to 300 cars per day and which can be increased to 400 cars per day by speeding up present units and adding more screens. Attention has been focused on reducing costs during the past several months. The results show that production costs of the Ward Sand and Gravel Company are considerably lower than those



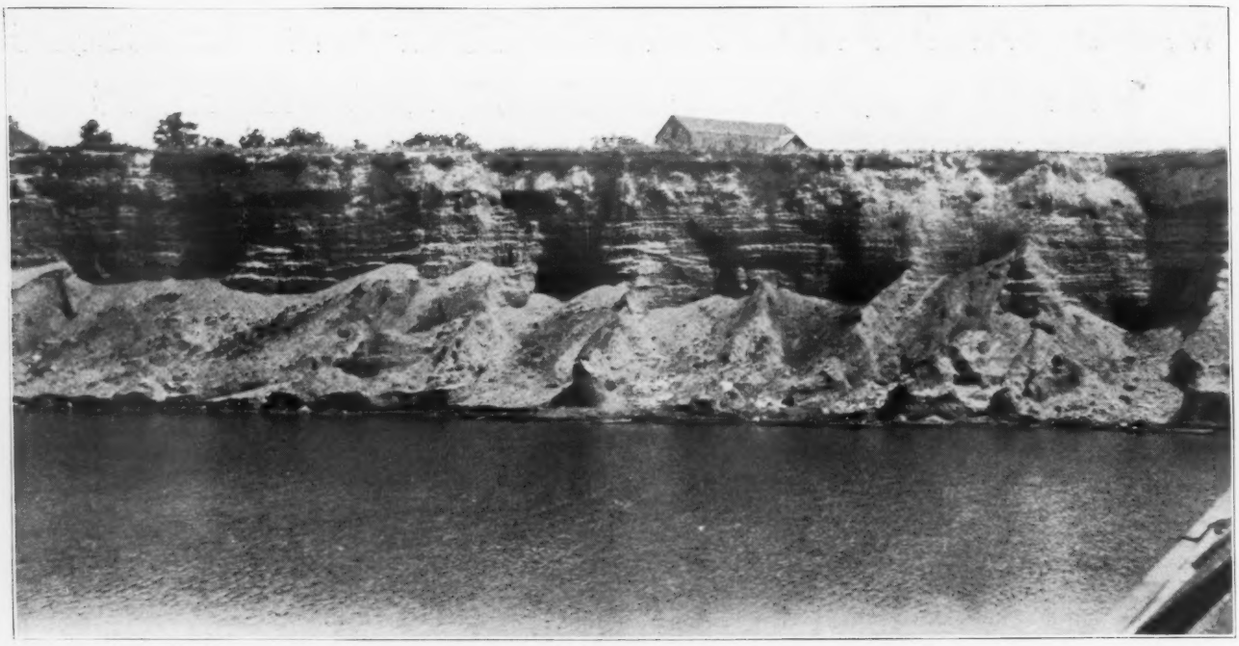
These Stones Were Handled With Ease by the Dredge Nozzle. This Illustration Gives an Idea of the Efficiency,

of any other plant with which the writer is familiar. Another reduction of at least 10 per cent will in all probability be effected by the first of September. The plant is particularly flexible. With three separate units, it is possible to produce from 60 to 300 cars per day with practically the same power and labor costs.

The deposit, covering 600 acres, is on the edge of the village of Oxford. This little village has a population of 2,000. The deposit lies in strata of about two feet of small pebbles, then a few inches of sand and the next strata of small pebbles and a few inches of sand. Clay and debris of all kinds are noticeably absent. Considering the whole deposit, the sand probably runs about 50 per cent. Engineers estimate that operations, producing at the rate of 300 cars daily, can be continued for 70 years to advantage. The deposit averages 150 feet



General View of Plant Showing Barge Unloading at Dock

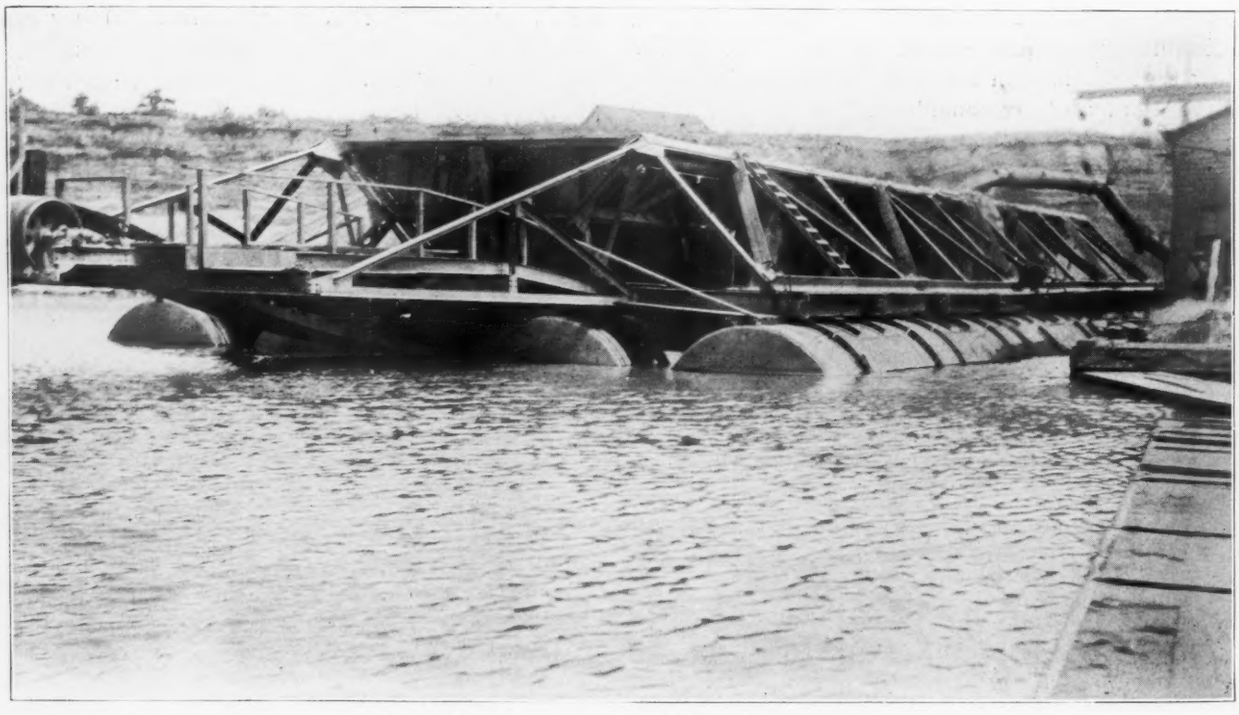


Nature of Deposit Can Be Seen Here

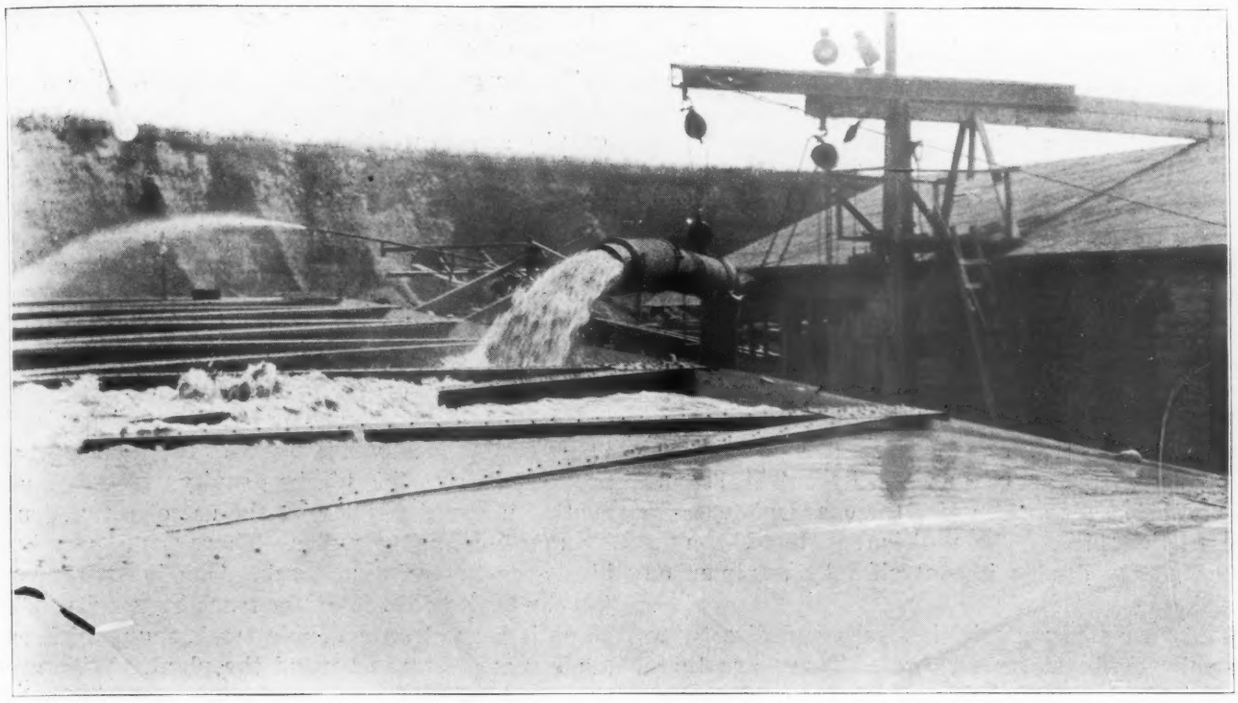
in depth and all of this can be excavated and shipped from the present plant position. The present lake covers twelve acres of the property. Material is excavated at present to a depth of 35 feet below the surface and with the 40 feet above the water there is a total working face of 75 feet. The methods being used by the company will operate efficiently at any desired depth.

Two years ago, the hydraulic elevator principle with variations was applied in excavating. Many engineers criticised this principle as applied to the commercial production of sand and gravel. However, the fact remains that for two years the Ward Sand and Gravel Company have successfully used the same method handling an average of 40 per cent solids. Abrasive wear has been confined entirely to comparatively small and inexpensive castings, which has alone effected economies of thousands of dollars per year.

A 6 foot 15 inch suction pipe projects at an angle of 45 degrees from a U-shaped 15 inch pipe line. One end of the U-shaped pipe line is connected by pipe line with a specially designed dredge equipped with Allis-Chalmers clear water pumps. The other end of the U-shaped pipe discharges directly to barges. The entire U-shaped pipe with



Barge Being Loaded. Note Tank Construction and Unloading Conveyor Shown at Left.



Dredge Pipe Discharging into Hopper Barge

the 6 foot 15 inch suction projection is submerged. The pumps on the dredge force clean water through the U-shaped pipe at a high velocity. As the water passes around the U in the pipe and over the opening of the suction pipe, sufficient vacuum is created to suck the material up through the pipe and into the U where the onrushing water carries it on and discharges it into barges. A six inch nozzle is placed just ahead of the suction nozzle which provides additional water and pressure to push the material along to its discharge. The short suction pipe has jet leads on the intake end. These are ¾ inch holes around the intake which are supplied with water under 150 pounds pressure. The eight jets of water break up the material in front of the suction pipe.

The U-shaped pipe is submerged at all times. If the pipe is too near the surface the material has a tendency to back up in the pipe. The lower the pipe is lowered the greater the amount of material excavated. The suction intake is entirely buried in the gravel because more material is excavated

Barge Conveyor Discharging on Dock

when the intake is crowded. Stone up to 15 inches in diameter can be handled with the present pipe but it is planned to increase the size so that stone up to 24 inches in diameter can be handled in the future. One of the illustrations shows the size of stones handled with ease by the dredge nozzle. The success in this plant with this principle is due largely to the jets of water around the intake end, the practice of burying the suction in the gravel and the pressure of the water above the submerged U-shaped pipe. This pipe is raised and lowered by means of a Thomas electric hoist located on the dredge. This dredge houses the pumping units and the starting resistances for the large motors.

A low pressure stream of water is directed against the bank above the water line. This stream of water loosens and carries the caved material to the suction pipe. The position of the U-shaped pipe and the dredge is controlled by deadmen on the shore.

The excavated material is discharged directly to specially designed steel barges. There are three of these barges, each with a capacity of 650 tons. These barges consist of steel hoppers with steel tanks instead of scows. The material is discharged into the steel hopper. The barge is then hauled to the shore plant. Underneath each hopper and between the two center steel tanks a 36 inch Manhattan belt conveyor receives the material through gates in the bottom of the hopper on shore for supplying the crushers. The barges are self clearing, everything being handled by gravity. The average distance of travel for the barges is now about 1,000 feet but it will eventually be about a mile and a half. This barge system is in fact a floating storage between the excavating and manufacturing units. As the length of barge travel increases, the number of barges will be increased.

The barge discharges to a hopper on the shore through which the material feeds to the main gravity screen, which is a 30 by 12 foot. The oversize material is screened out and delivered to a large size Cedar Rapids crusher. This crusher discharges to a 300 foot center Manhattan belt conveyor that delivers the crushed material along with that passing the screen to the main plant. Two belt conveyor units are maintained as shown in the illustration. The crushing plant consists of seven Cedar Rapids crushers in all. This 30 inch Manhattan tunnel belt conveyor regates and carries it up an incline to a loading bin over the tracks. Cars are loaded from this bin by gravity. The cars are spotted under the bins with the use of a two drum Thomas hoist as car puller. There are two loading bins over the railroad track. The incoming cars jolt the loaded cars down the track by gravity. The plant is located on a double track spur which extends some distance beyond the plant. With continuous loading a car, on the average, is loaded every two minutes. The trestles for the conveyor belts and pipe lines are built of heavy timber. The tunnels are also lined with timber. The loading bins are built of heavy timber.

The plant is electrically operated by power purchased from the Detroit Edison Company. Each unit is driven by individual Allis Chalmers and General Electric motors. The plant is electrically operated throughout. The large motors are 3 phase 60 cycle 2,300 volt and some of the smaller motors are 220 volts. All are Allis Chalmers and General Electric motors. There is a total of 2400 h.p. The output is consumed largely in the construction of

Double Conveying Unit to Maunfacturing Plant

roads, buildings and concrete bridges. A considerable portion of the output is also consumed by the railroads, who haul in a train of freight cars and have it loaded in a few minutes without disconnecting the engine.

The Ward Sand and Gravel Company has two and a half miles of railroad siding at the plant and shipments are made over the Grand Trunk Railway System and the Michigan Central. Single cars have been loaded in thirty seconds but for continual loading the record is 31 cars loaded in 62 minutes. No expense has been spared in perfecting the apparatus and the operation in which the same is used and in making this plant one of economical construction as well as one havign the largest and most dependable production. Operations extend through seven or eight months of the year.

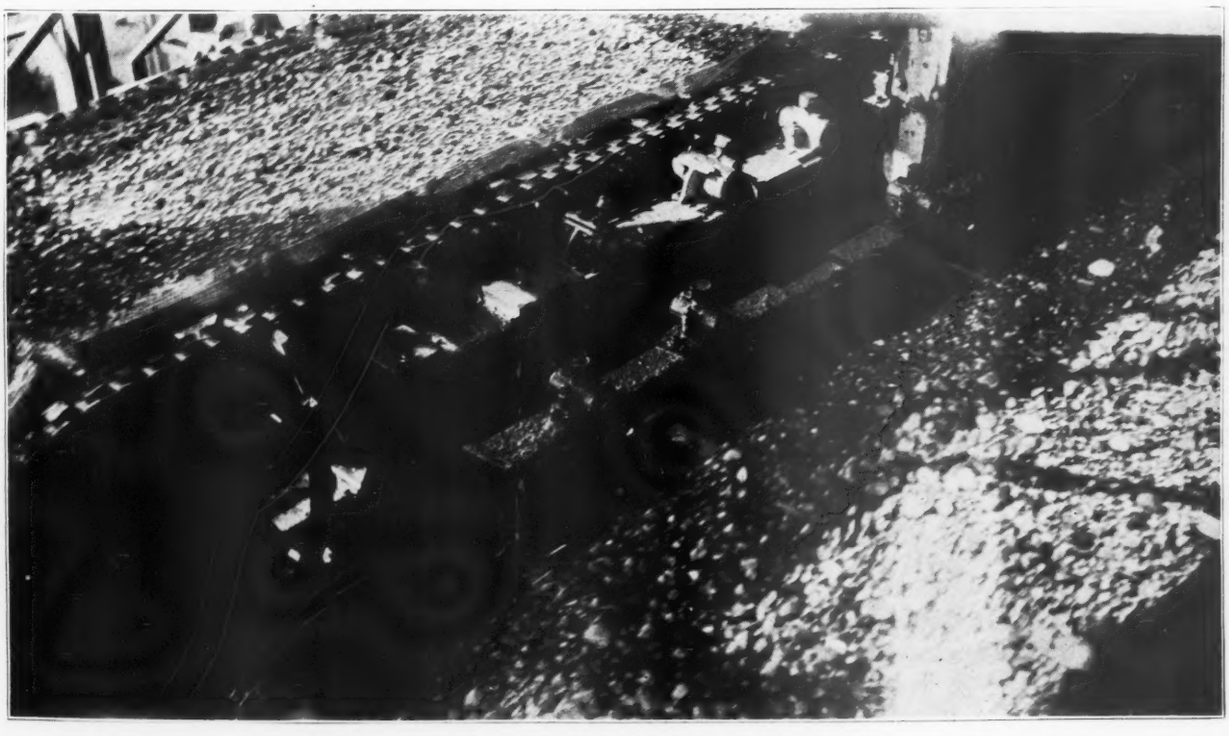
Mr. F. L. Ward is president of the company and is responsible for the design and layout. He has succeeded in demonstrating that his theories are practical and decidedly economical. This plant undoubtedly produces material cheaper than any other sand and gravel plant in the United States and on a larger scale than any other single unit. With a total production force of 44 men (22 to a crew) an average of 300 cars of sand and gravel can be produced daily. This fact alone places the plant in a class by itself, but when one estimates the capital investment and studies the operating and maintenance costs one is frankly astonished at what has been accomplished by Mr. Ward. One also realizes the courage and conviction necessary to proceed to the present development without encouragement; in fact, with ample discouragement from engineers and manufacturers.

Road Builders Launch Campaign to Combat Highway Accidents

In line with a resolution passed by the Federal Council of Churches in America condemning the appalling loss of life on public streets and highways the American Road Builders' Association will make a direct appeal to 30,000 churches in the United States to launch a campaign in behalf of highway safety during the month of October, and in addition will carry the safety movement into all schools, civic clubs and motorist organizations.

Charles M. Upham, business director of the association, is directing the movement. A National Highway Safety Club will be organized as a vehicle for the spread of constructive highway safety information. Every citizen of the United States will be asked to become a member of this club and to cooperate in an effort to reduce the loss of life. Membership in the club will be without charge and will be granted to all persons signing a pledge to practice reasonable caution and courtesy while on the street or highway.

A unique feature of the campaign will be the elimination of the usual list of confusing safety rules and the substitution of the simple ethics of courtesy and caution. "The individual alone is responsible for highway accidents," says Mr. Upham. "The American Road Builders' Association will make its appeal directly to each individual citizen rather than to the masses." The results of the campaign will be reported during the annual convention of the Association at Cleveland on January 9.



One of the Belt Traveling Screens

Use of Imported Cement Not Justified

On the broad general principle of the welfare of this country, certain factors must be considered in arriving at a decision as to whether there is a real benefit through the importation and use of foreign cement, said Louis R. Ferguson, vice-president and general manager of the Louisiana Portland Cement Company, in an address before the New Orleans Commission Council on July 21, 1927.

It is acknowledged that foreign cement can be manufactured and transported into certain sections of the United States at a price which is less than domestic concerns can make it, operating under American methods. This is due mostly to the great difference in wages which we pay our employees as compared to the wages paid in foreign countries.

Taking the average for Belgian cement mills, labor gets the equivalent of 98 cents in American money per day. American cement is made by men receiving approximately five times that much. The 10,000,000 barrels of foreign cement which has been brought into the United States during the past four years has cost American wage earners over $10,000,000. In considering a theoretical saving claimed for the use of foreign cement, a number of factors must be weighed.

It is a question who obtains the margin of profit represented by the difference in the cost of domestic and foreign cement. It would be interesting to look into contracts where foreign cement has been used and determine if the one who actually paid the bill was charged any less because cheap foreign cement was employed.

Manufacturers of cement abroad under their laws have been able to combine in cartels or trusts, pool their sales, or allocate their products, practices forbidden American manufacturers under the anti-trust laws. In the export trade, this might lead to the shipping of both good and poor brands of cement in cargo lots.

Since cement comes over at a very low freight rate, frequently serving as ballast, the buyer of foreign cement, likely to receive some poor cement in cargo lots, finds the ocean between him and the place where he must ask redress. If anything goes wrong with American cement, the manufacturer is on the ground with the reputation of his product to protect.

Trans-Atlantic transportation is as great a menace to portland cement as is long time storage in damp climates. Buyers of foreign cement in large quantities must constantly guard against the following drawbacks:

1. Lack of uniform quality, due to the mixing of various brands of cement in cargo lots.

2. Deterioration of cement, due to moisture from sweating of steel bottoms, steam, salt water, storms, etc., en route, and long time storage in warehouses under damp climatic conditions.

3. Irregular weights due to sifting of cement from coarsely woven jute sacks during frequent handlings incident to such shipments.

4. Reconditioned or renovated cement. This is cement which has deteriorated, sifted out of sacks, or become lumpy and been reground, rescreened and resacked.

These important drawbacks are absent in the case of American brands of portland cement. As the mill is always near its market, storage of large quantities or for long periods in damp climates is not necessary. Furthermore, uncertainties as to delivery, due to the danger of deterioration, shortage of ships' bottoms and hazards of the sea, are absent in the case of American cement, and delays due to failure of deliveries from whatever cause are costly, nor can the buyer or the contractor insure himself against loss due to such delays in the case of foreign cement.

The American cement manufacturer would naturally be loath to have his product used in the same job with foreign cement in such a way that responsibility for accidents due to inferior cement could not be fixed. To an extent which is true of no other industry or any other country, American manufacturers have worked to safeguard at once their own product and the consumer of their product from inferior quality and improper uses. To have a product so safeguarded mixed in with a product of a country and an industry where such safeguards do not exist would be seriously to jeopardize the results of long years of effort and tremendous expenditures for the protection of manufacturer and consumer alike.

The fact that this country has millions of miles of concrete roads and city paving, hundreds of millions of modern, sanitary office buildings and large and small residences largely of concrete construction is due to the fact that the American manufacturer not only made cement and taught the American people its advantages and widespread uses, but guarded its consumer from misuses of the product and consequent losses. Without seeking the wealth created by other products, he created a new product and a new wealth, which he distributed throughout the Nation.

Cement is one of the most, if not the most, important manufactured product of Belgium today. Relatively, it is one of the least used within Belgium. Only recently have any serious attempts been considered to create a demand for the product within Belgium. To all practical intents, there is not a concrete road in the country. A powerful political ring, controlled by cobblestone people, dictates the road building policies. Instead of creating new wealth within her own borders, the Belgian industry turned to a division of wealth in other markets created by others.

HYDRAULIC STRIPPING IN THE INDIANA LIMESTONE DISTRICT

AN UNUSUAL SYMPOSIUM OF PRACTICAL EXPERIENCE

WHEN a man and team could be hired for $1.50 a day, a satisfactory method of stripping the overburden of soil and clay in the Indiana limestone region between Bloomington and Bedford involved the use of teams, plows and scrapers. But mounting costs of labor eventually made this prohibitive. Electric power was introduced, and stripping was speeded up and cheapened through steam shovels and hydraulic stripping pumps. Fifteen years ago, there were only a few stripping pumps in this district, and they were mostly a novelty and an experiment. Now it is known that they provide the cheapest way to move dirt, and every quarry in the district, with one or two exceptions, owns and operates a hydraulic stripping outfit.

The oolitic limestone here is under four distinct strata. First is the layer of topsoil and clay; second a mixture of clay and "spawls"; third a layer of Mitchell limestone, a hard, flintlike, blue stone; and fourth a layer of soapstone. Each of these varies in thickness from a few inches to several feet. In the Sanders district, south of Bloomington, the total overburden runs as high as 70 feet, while in parts of the Hunter Valley district, north of Bloomington, the soapstone and Mitchell limestone are absent, and the oolitic stone lies under a layer of about four feet of topsoil and clay, and a couple of feet of spawls.

It is in the removal of the topsoil and clay and the layer of spawls that hydraulic stripping is effective and economical. Where the soil and clay is loose, or reasonably so, you can shoot a stream of water from the one-inch nozzle on it, and it will bite and dig away this soil at a rate that would astonish the old time stripping contractor. A half an acre area four or five feet thick can be stripped in two or three weeks. Besides doing it quicker, the cost is less than when teams or steam shovels are used. The hydraulic stripper is used to take off the topsoil and clay, then the other layers down to the oolitic stone are drilled and shot, and this debris removed by steam shovels. In a few cases the derrick and steel or wood grout boxes, holding two or three yards, are used instead of steam shovels.

The water supply is not a problem, in most cases. It is there in abundance, in the old quarry holes. The spillway usually drains back into the old hole, the water being used over and over again. The cost of stripping per yard, the yardage per hour, the exact cost as compared to team stripping or steam shovel, are difficult to obtain because of varying conditions. No two quarries present the same problems.

Vaughn Graham of the Indiana Limestone Company, who owns and operates most of the quarries in this section, says that hydraulic stripping costs about one-fourth as much as teams and scrapers, although this will vary with different quarries. Recent figures show the yardage cost of hydraulic stripping to be about 15 cents, while team stripping costs from 60 to 65 cents a yard. A factor favorable to hydraulic stripping is that it goes down and digs the dirt out of holes and crevices in the rock, which has to be removed with pick and shovel when teams or steam shovels are used.

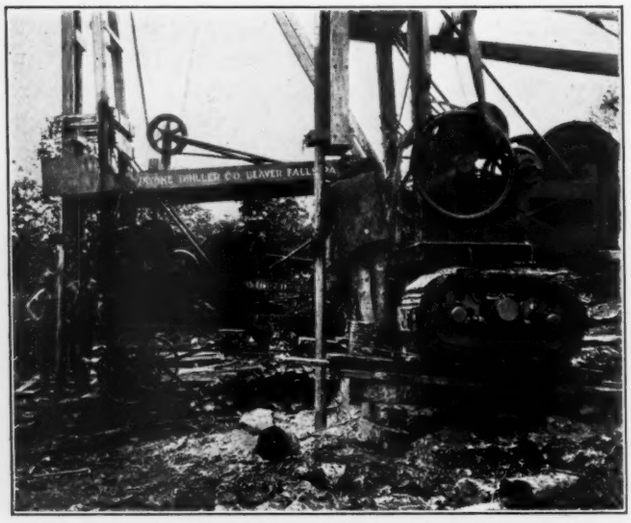
The outfit used in this district consists of a centrifugal pump, an electric motor, a pipe line and a brass nozzle. The pump is usually driven by a 100 h.p. motor, both of which are housed in a small pump house on the edge of the water hole. It connects with a six-inch pipe line, which is usually reduced to a five-inch, then connected to the nozzle with a four-inch pipe. The length of the pipe line varies with local requirements, some of the quarries using only one or two hundred feet, and others using a line up to 2,000 feet long.

General Electric and Westinghouse motors are used. A wide range of pumps are used, the Cameron, American, Dean, Worthington, Allis-Chalmers, Morse, and others being represented. The nozzles are manufactured by the Universal Nozzle Company of Indianapolis. They are made of brass, and equipped with swivel joints so the stream of water can be trained up or down, or sidewise. Specifications of the Indiana Limestone Company require a pressure of 175 pounds per square inch at the nozzle, with a one-inch nozzle. That is, of course, a minimum requirement, and it frequently happens that a much higher pressure is used regularly. The one-inch nozzle is used for cutting hard material. For the average job the pressure supplied by a 1⅛-inch nozzle is sufficient, and for washing away loose dirt frequently a 1¼-inch nozzle is used. The advantage of the larger nozzle is that more volume is obtained. On the average stripping job, about 600 gallons of water a minute are used. The cost of such an outfit, including the motor, pump, pipe line and nozzle, is from $2,000 to $2,500.

Operating costs are more easily obtained than are yardage costs. Three men are employed ordinarily—one to watch the pump and two to operate the nozzle. Their time is figured at $20 a day. This amount can be reduced by dispensing with

Stripping at the National Quarry

After Top Soil Has Been Removed at Chicago and Bloomington Quarry in the Hunter Valley District



Closeup View of Churn Drills at Sanders Quarry

either or both the pump man and the helper. But it isn't considered good management to do this. The nozzle man needs help when he wants to move the nozzle, and with the helper there they can run right through the noon hour. One quarry tried doing without a man at the pump, but one day the bearings were burned out at a cost of $500 and two weeks' delay.

Based on the operation of the pump only, the power cost for a 10-hour day, 24 days a month, is about $450 a month. In most cases, however, power is used for other machinery at the same time, and because of rate structure, this decreases the pump operation cost. In some favorable instances, the power cost does not exceed $250 a month.

The Mathers stone quarry of the Indiana Limestone Company, in the Sanders district, is one of the few that does not use a steam shovel. The topsoil and clay are removed by the stripping pump, then the layers of stone are drilled and shot, and the debris removed by derrick and steel grout boxes. The water supply here comes from an old quarry hole, 60 feet deep. A 300 foot pipe line is used, with a Dean centrifugal electric pump, driven by a 100 h.p. motor. The pipe line is six inches diameter at the pump, reduced to five inches, then to four inches at the nozzle, and finally the tip of the nozzle is 1⅛-inch diameter. The pressure of the water at the nozzle is 180 pounds per square inch. The nozzle is a Universal style A. The 1⅛-inch tip is used ordinarily. They have used a 1¼-inch tip when a considerable quantity of dirt was being moved, and when it was extremely hard and more pressure was desired, they have used a one-inch tip.

One man is on duty all the time in the pump house, and one man operates the nozzle. With only two men employed, this quarry figures labor cost at $13 a day. The topsoil here runs from four to six feet thick. The spawls are smaller than the average. They are loaded by hand labor in groute boxes holding two to three yards, and moved by the derrick. After these spawls are removed, there remains about three feet of clay. This is hard, almost as hard as stone, but the nozzle is hooked up and turned on it. When this is cleared away, the pump is shut down and the nozzle stored until the next "ledge" is ready to be opened.

Drills and dynamite break up the Mitchell and soapstone strata and this is disposed of by the grout boxes and derricks. The ordinary expectation in this quarry is to strip the top layer of a tract 125 by 125 feet in three weeks. The spawls are then removed, and the tract is stripped again, taking about three more weeks. "For the top layer of soil and clay, and for any layer of clay, there's nothing that will beat a nozzle stripper," says J. C. Edwards, quarry superintendent. "It is the most economical and the quickest method we have ever used."

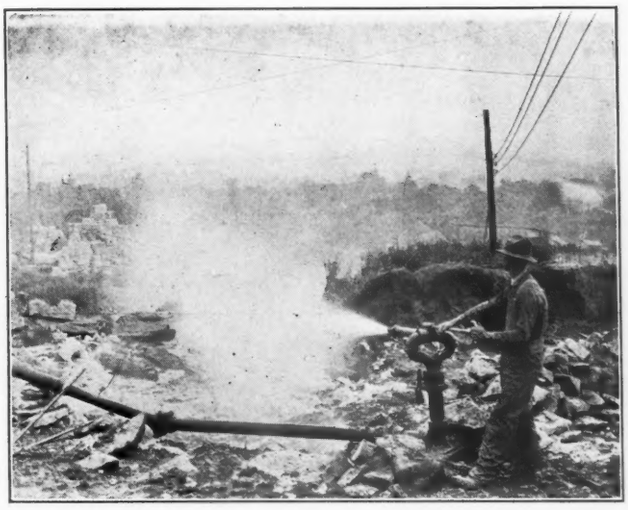
Illustrating the fact that practically every quarry here presents a different set of conditions, there's the Chicago-Bloomington Stone Company, located just west of the Mathers quarry. This is one of the few that doesn't use a stripping pump, and the reason is that there's no water available. Their stripping work is done with steam shovels—a Bucyrus 50-B, and a small Northwest shovel. This company operates a quarry in the Hunter Valley district, where a hydraulic stripping outfit has been used with marked success. Here, there's a topsoil of four to five feet, a five foot layer of spawls, and a three foot stratum of Mitchell limestone.

An unusually long pipe line is used—1,700 feet. This was necessary because it is a new ledge, opened a few months ago, and the nearest water supply was 1,700 feet away. A 150 h.p. Allis-Chalmers motor is used, with a four-stage Morse pump. A five-inch pipe line is used all the way, except for a four-inch connection at the nozzle. This outfit was installed and started operating in January, 1927.

Before that time, teams and scrapers were used. While expensive, the cost was not prohibitive in this case because of the thin topsoil. However, George Miller, foreman, has figured the cost of team stripping at 50 cents a yard, and hydraulic stripping with the new outfit at 8 to 10 cents a yard. A Universal nozzle with one-inch tip is used. Sometimes when more volume is required to wash loose dirt, a 1¼-inch tip is used.

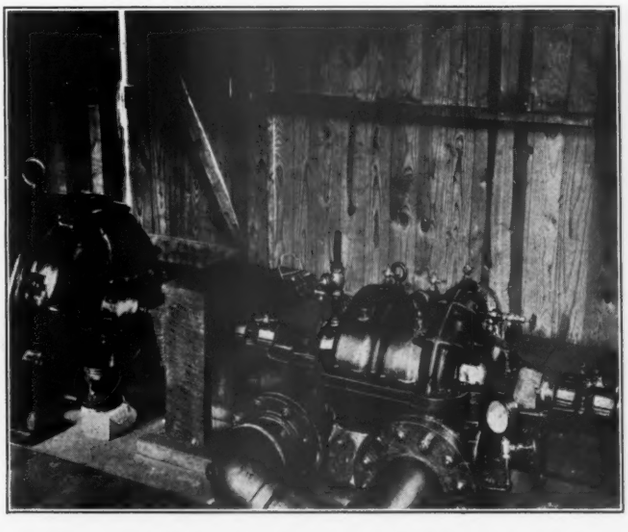
Two men operate the nozzle and one man is on duty at the pump. Operating costs for labor are $20 for a 10-hour day, and for power about $12, making a total operating cost of about $32 a day. When the dirt is removed, the stratum of Mitchell limestone is drilled and shot. Large chunks are picked up by the derrick, and the rest of the debris cleaned up with a Pawling and Harnischfeger shovel, operated by gasoline motor, with ¾-yard dipper.

The Sanders quarry of the Indiana Limestone Company is about a mile south of the Mathers quarry. The oolitic limestone lies under an overburden of about 60 feet. First is a layer of topsoil and clay four to six feet thick, then a three foot layer of spawls and clay, then a 20 to 35 foot stratum of Mitchell limestone, then a 20 to 30 foot stratum of soapstone. To remove the topsoil, a Universal turret, style A nozzle with a 1¼-inch tip is used. The clay is hard in spots, but the stream hits it with a force of 235 pounds per square inch, and digs it away with no difficulty. The surface is irregular, but sloping toward the old holes that have been worked. When opening a new ledge, the nozzle is set at the lowest corner and stripping begins there, the nozzle being moved back as the dirt is washed away. The dirt drains back into the



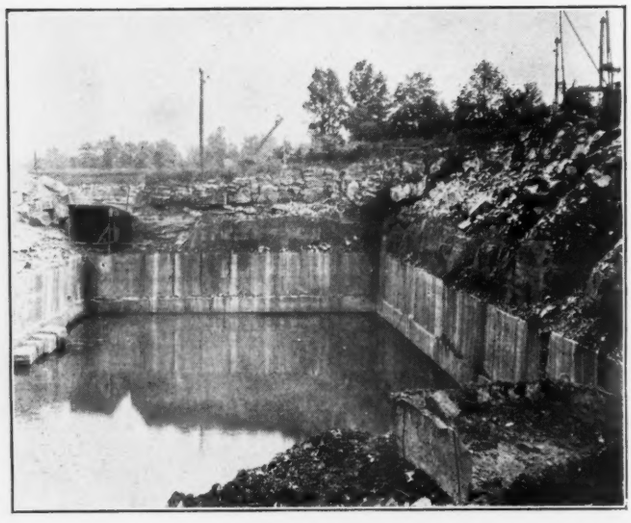
Hydraulic Stripping Monitor

Stripped Ready for Channelling Machines

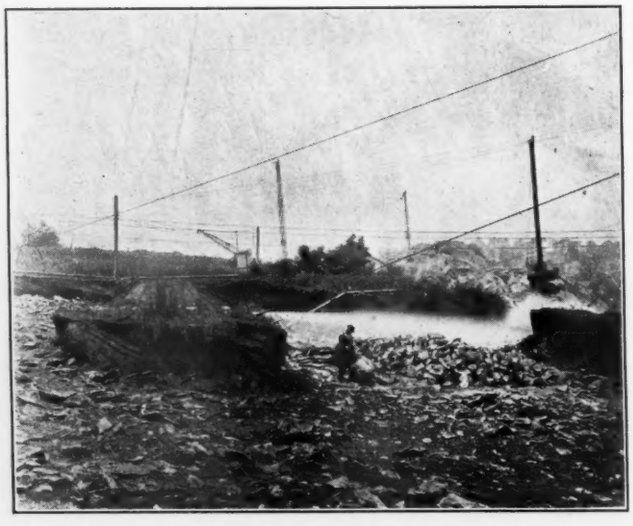


Pump and Motor at National Quarry, Sanders District

Stripping at National Quarry



Water Hole at Sanders Quarry



An Example of the Overburden Remover

water hole. A 550 foot pipe line is used—450 feet of six-inch pipe connecting with the pump, reduced to four inches at the nozzle.

When the topsoil is cleared away the drills are moved in—two number 3½ Keystone electric churn drills with 15 h.p. a.c. motors, and they sink six-inch holes down to the soapstone. This is shot, the large chunks removed by derrick to dump cars, then a Northwest shovel, model 105, with 40 h.p. a.c. motor and one-yard dipper, is used to pick up the smaller stone and clay. This debris is dumped into 8x8x2 foot steel grout boxes, which are moved by derrick to dump cars, and hauled to the dump heap. After the Mitchell limestone has been removed, the same process is repeated for the soapstone.

A Cameron three-stage centrifugal pump, driven by a 100 h.p. a.c. motor, is used. It develops a pressure of 275 pounds per square inch at the pump, and 235 pounds at the nozzle. This outfit was purchased and installed in October, 1925. Three men are employed. Having a helper has its advantages, says George Reed, general superintendent. It keeps the nozzle running during the noon hour, provides an experienced man if the operator lays off, and the two of them can shift the nozzle when required. The operating cost for a 10-hour day is $20 for labor and about $15 for power, a total of $35.

Here as in the case of the Mathers quarry, no attempt has been made to figure the yardage that can be removed by a stripping nozzle, because the soil and clay may be loose, or it may be very hard—you never can tell until you start work on it, said an experienced nozzle man. If the soil is loose, the stream of water tears it out and washes it away in great chunks. If it is hard pan clay, the yardage may be reduced as much as 90 per cent. But Mr. Reed says it is the most economical and efficient method in use, and it works about twice as fast as a steam shovel. They had a tract stripped ready for the drills when the editor of Pit and Quarry called. This was 200 by 140 feet, the soil and clay being four to six feet thick. It was stripped in four weeks, the nozzle being at work about 75 per cent of that time.

The National quarry of the Indiana Limestone Company, in the Sanders district, has to contend with an unusual problem in shortage of water. This quarry operates two ledges, and has two nozzles, both supplied with water from one pump. Each of these ledges drains away from the water supply. Pumping at the rate of 36,000 gallons an hour, it doesn't take long to use up even a large supply of water, and the only recourse is to run as long as the water holds out, then shut down and wait for rain. However, this condition does not greatly hinder the work, for most of the stripping is done during the spring and early summer when water is plentiful. And there are always

times when the pump is shut down to move the nozzle, and other natural delays.

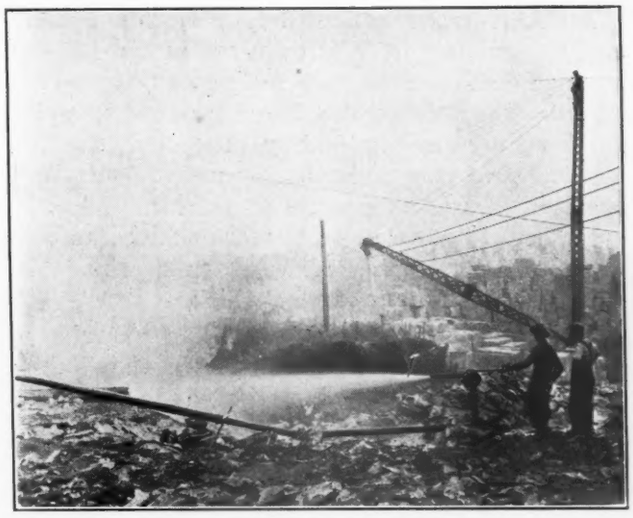
At this quarry they were finishing a tract 250 by 125 feet on the west ledge. Here the topsoil is from four to seven feet thick, resting directly on the oolitic limestone. The stripping on this ledge, therefore, is simply a question of removing the topsoil. Stripping started on this tract the first of May and it was ready for the channeling machines the first of July—a period of two months. Actual working time was about six weeks.

Three men are used. Operating costs are about $19 a day for labor and $18 for power—a total of $37. The cost for power here is above the average because better results have been obtained with a 150 h.p. Westinghouse induction motor. A Hill three-phase centrifugal pump is used. This pump was installed last June. It is an old one with several years' service in another quarry. When first installed it was hooked up to a 100 h.p. motor, and then to one of 125 h.p. Neither of these was satisfactory because they did not develop enough pressure at the nozzle. Now, the 150 h.p. motor gives a pressure of 180 pounds per square inch, with a 1¼-inch nozzle.

For 17 years this quarry has used hydraulic stripping, formerly using a steam pump, supplied by a boiler that furnished steam for the mill and derrick power houses. The maximum pressure was 95 pounds per square inch at the nozzle. Although the operating cost of the steam pump is much lower, the new outfit is more efficient and more economical because of the higher pressure which moves the dirt faster.

On the east ledge, under the topsoil there's a 10-foot layer of Mitchell limestone. This is drilled, shot, and removed by derrick and grout boxes. The two pipe lines, one to the east and one to the west ledge, are each 800 feet long. Hydraulic stripping has been a big success at this quarry. The old team method was expensive, slow and unsatisfactory. There are ruts and crevices in the stone here which the scrapers couldn't reach, but the stripping nozzle cleans them out with no more effort than it tears away the topsoil and clay. Says Abner Umphreys, old-time quarry boss in charge of these two ledges: "This outfit will move more dirt for a dime than teams will move for a dollar," and cost figures at the office bear out his assertion.

Frank Mathews, general superintendent of the Empire Stone Company quarry in the Sanders district, is conducting an experiment to determine to what extent the shape of the tip affects the pressure at the nozzle. This experiment is being observed with much interest by other quarry officials. The stock seven-inch tip has been lengthened to 12 inches, the last five inches being straight. This added length, according to workmen who have used it, concentrates the stream and stops all spraying, giving it much additional pressure.



Stripping Goes on Adjacent to Active Quarries

Results of Hydraulic Stripping of a Difficult Job at Sanders Quarry

Steam Pump Used for Hydraulic Stripping at Hunter Bros. Quarry

An Allis-Chalmers 5 x 6 type H Y C centrifugal pump is used. It is operated with a 125 h.p. motor. The cost of this motor and pump was $2,250. The nozzle cost $125. Hydraulic stripping has been used in this quarry since 1907, the first outfits being operated with steam pumps. Only one man is used to operate the nozzle. When he needs help to move it, or to move spawls, he calls for help from a gang of workmen nearby. The topsoil here is four to six feet thick.

At the Crescent and Worthington quarries of the Indiana Limestone Company in the Hunter Valley district, there's a topsoil of six to eight feet. Under this there's an eight-foot layer of spawls and clay, then a thin stratum of Mitchell limestone. A Cameron three-stage centrifugal pump with 100 h.p. General Electric motor is used. The pipe line is about 800 feet long. Three sizes of tips are used, 1-inch and 1⅛-inch for cutting hard clay, and 1¼-inch for washing off loose dirt.

The general practice here is to shoot the layer of Mitchell limestone, if it is underlaid by a four or five inch bed of clay. This clay acts as a cushion and prevents cracking of the oolitic limestone underneath. The stone is shot in ledges, afterward broken up and removed by derrick and grout boxes. If this bed of clay is absent, the Mitchell limestone is quarried by the channeling machines and removed in the regular way by derricks.

This is an old quarry with several deep holes, and these are used for dumping refuse stone and dirt, and to catch the mud and water from the stripping nozzle. It is one of the pioneers in the use of the stripping pump. Back in the old days, experiments were first made with an ordiary rubber hose with brass hand nozzle. But it was not successful because sufficient pressure to cut the dirt made the hose whip around like an angry snake, and many men were required to hold it. When it did go on a rampage, it knocked the men down and scattered water all over the place. Then when the present nozzle was devised, a 15 foot section of rubber hose was used to connect with it. This made it easier to move the nozzle, but the strongest hose obtainable would not stand up under the rough usage.

Here, as elsewhere, iron pipe is coupled direct to the nozzle. This has been found to be the most satisfactory method, except that when necessary to move the nozzle, the pump must be shut down while the pipe is being uncoupled and coupled again. This is the chief problem of hydraulic stripping, says Fred Beck, quarry superintendent, because these shut-downs consume about 25 per cent of the time. A good stripping outfit is 60 to 70 per cent cheaper than teams and scrapers, according to Mr. Beck. A tract 200 by 145 feet had just been stripped here, ready for the drills. The time on such tracts varies from 60 to 90 days, depending on the depth and condition of the soil and clay. This particular one took about 80 days.

Hunter Brothers' quarry in the Hunter Valley district still uses a steam pump, purchased years ago from the Lafayette, Indiana, water works. Steam to operate it is supplied from the boiler which runs the stone mill nearby. Because of the low pressure supplied by this pump, its operation is not as economical as an electric driven pump, although it does have an advantage in being cheap, the power costing practically nothing. Two men are used on the nozzle. Labor cost is figured at $20 a day, this including the fireman's wages. "A good stripping pump outfit," says the foreman of this quarry, "will do as much work as twenty teams."

Selling Safety With Letters

If letters can be made to sell Pit and Quarry products to the consumers, can they not also be made to sell safety to the personnel? In large institutions having several plants located at some distance from each other there is a real excuse for an executive to write superintendents and foremen. In small plants, the obvious thing to do would be to talk with the foremen personally. This being done in the majority of cases, letters are unusual, and the unusual attracts attention. Thus do letters apply to both large and small concerns.

Lacking the cooperation of the foremen, no safety program can hope to succeed. Foremen are your media for direct contact and they not only must be sold on the idea of safety but kept sold. As in any direct mail campaign, a single letter will not suffice. They should be in series and mailed at varying intervals of from two to four weeks. Variation in time, because it keeps the letters from becoming a looked for, periodic occurrence.

Similar to a sales letter, your safety letter must be long enough to give the reader an intelligent understanding of the idea or subject; yet brief enough to hold the reader's attention. Seldom should letters of this character be longer than a single page.

Too much detail or too much generality is to be avoided. Let the safety letter contain concrete, relevant facts, or problems that compel thought. The best "cases in point" to write about are those with which the reader is familiar. A few subjects for safety letters are:

Principal causes of accidents.
Material handling.
Mechanical guards.
The inexperienced workman.
Who is responsible for accidents?
A means to better production.
Why are accident records kept?
When the foreman fits—into Safety.

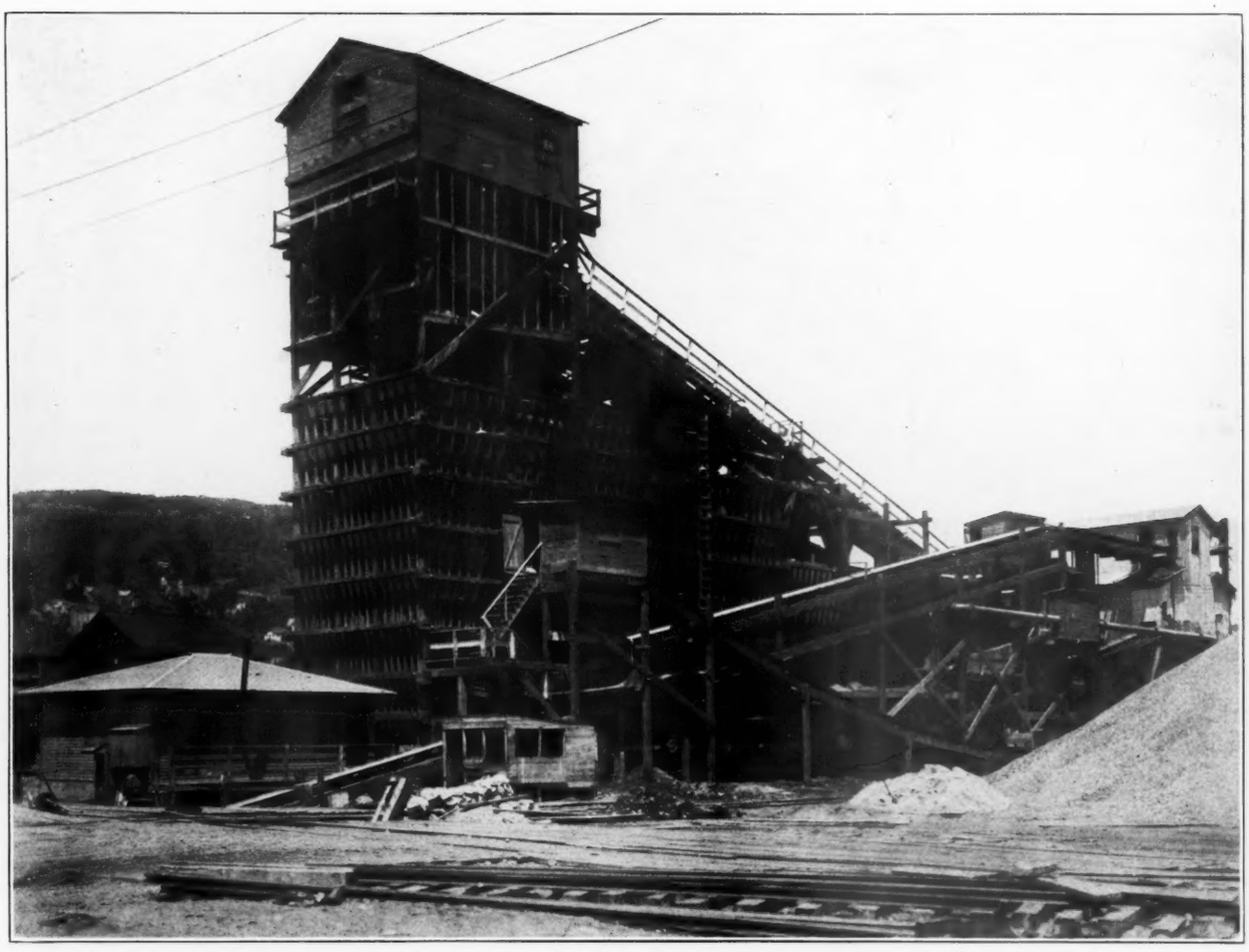
EFFICIENT SAND AND GRAVEL OPERATION CONDUCTED AT HEAD OF LAKES

SAND and gravel are produced on a large commercial scale at Duluth, Minnesota, by Whitney Materials Company, who maintain offices and distributing yards at Duluth and Superior. Their sources of supply include an exceptionally fine deposit known as the Boulevard Pit, located within the city limits of Duluth, up the hill a distance of about one mile from the business section. Another deposit which runs about 95 per cent gravel is located at Grand Marais, Minnesota, on the north shore of Lake Superior. Others at Isle Royale and the Apostle Islands give access to high grade materials having a predominance of sand.

Finding a suitable location for their new screening plant which was erected during the winter of 1926-1927 was somewhat of a problem. It had to be on the water front with good dock facilities to receive raw materials brought in by tug and scow from Grand Marais, Isle Royale and the Apostle Islands, and also to permit loading scows with washed and screened sand and gravel for delivery to construction jobs on or near the water as well as for making delivery to other distributing yards operated by Whitney Materials Company in Duluth, Superior, and Ashland. The plant had to be within economical trucking range of the Boulevard Pit and located on a railroad within a favorable switching district which provided adequate track facilities for car load shipments. Still another requisite was that the plant site be so located geographically as to serve for the main distributing yard.

All of the requirements were met by purchasing and leasing additional ground space adjacent to the company's distributing yard located on the water front in one of the outlying business districts. It was, however, necessary to construct an expansive dock with storage capacity of 100,000 cubic yards for loading, unloading and storing materials. The solution of economically transporting raw materials down a 10 per cent grade for a mile and a half from the Boulevard Pit was made by putting into service a fleet of trucks and 4-wheel trailers.

At the Boulevard Pit, raw materials are dug, and trucks and trailers loaded with an Erie Gas+Air one and one-quarter cubic yard capacity caterpillar



Rear View of Screening Plant. Capacity 1,250 Cubic Yards per Ten-hour Day.

shovel. The shovel has convertible equipment consisting of a boom and clamshell for handling washed and screened sand and gravel at the main plant when pit operations shut down, or at such times as occasions may require. Composite derrick scows with 80 foot booms and three and one-half cubic yard capacity Williams clamshell buckets dig their own loads from deposits on the North Shore and the islands of Lake Superior. During the season when navigation is open, these scows, towed by large size lake tugs, ply between their loading points and Duluth carrying loads averaging 1500 tons.

All of the marine equipment, including the tugs, scows, derricks, and shear clamshell buckets for quick unloading, were designed and built by the parent company, which operates under the firm name of Whitney Brothers Company. Complete machine shops and dry docking facilities are maintained by the parent company for keeping all equip-

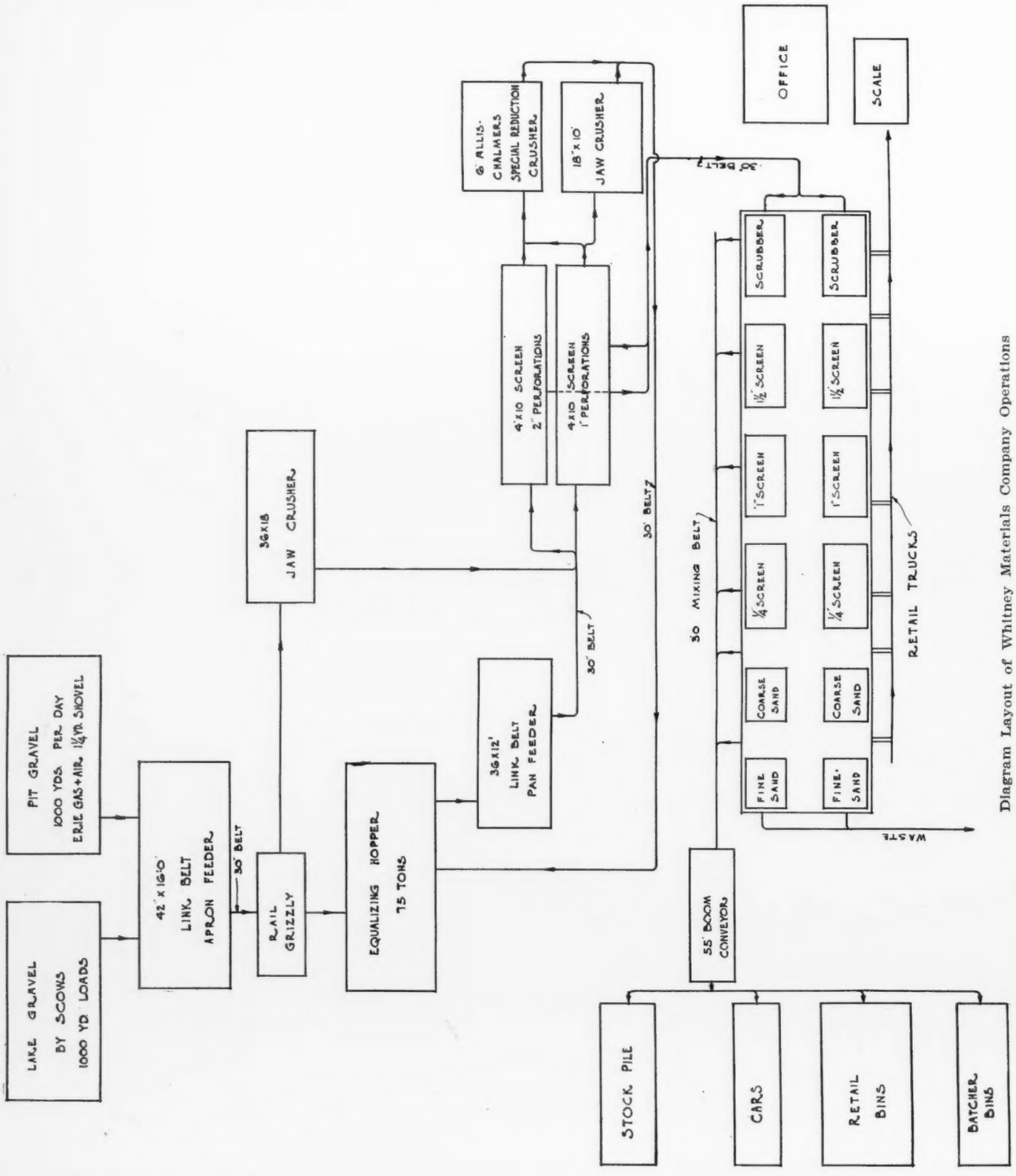
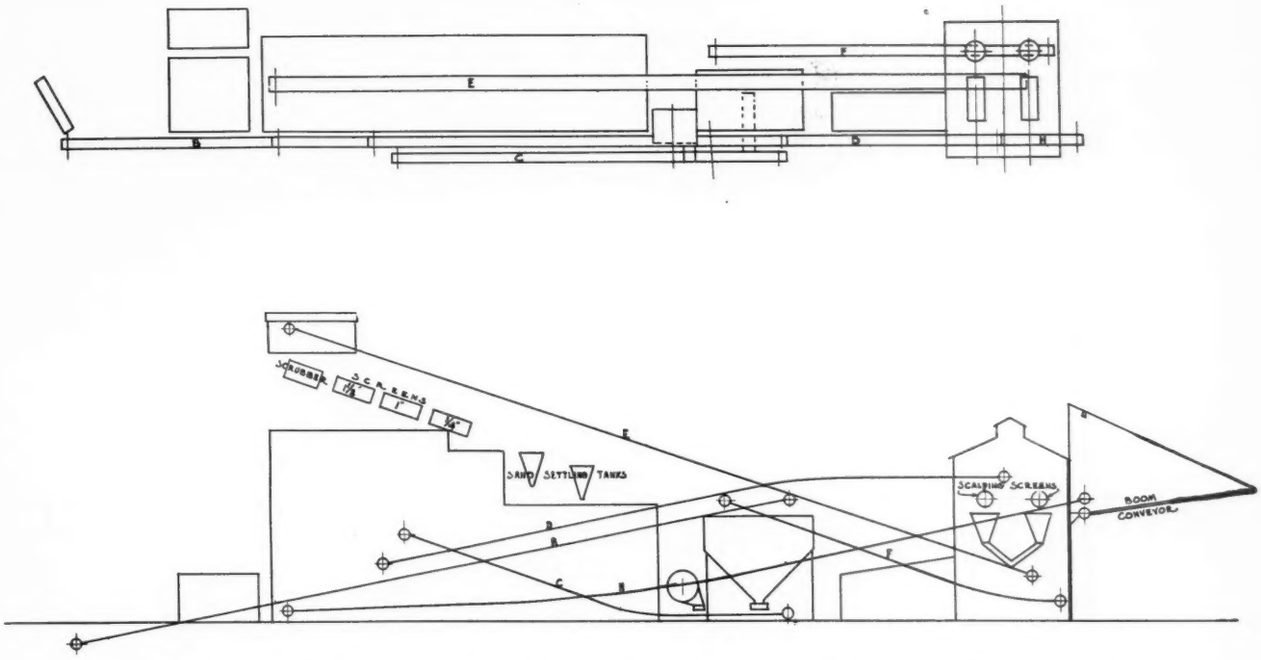
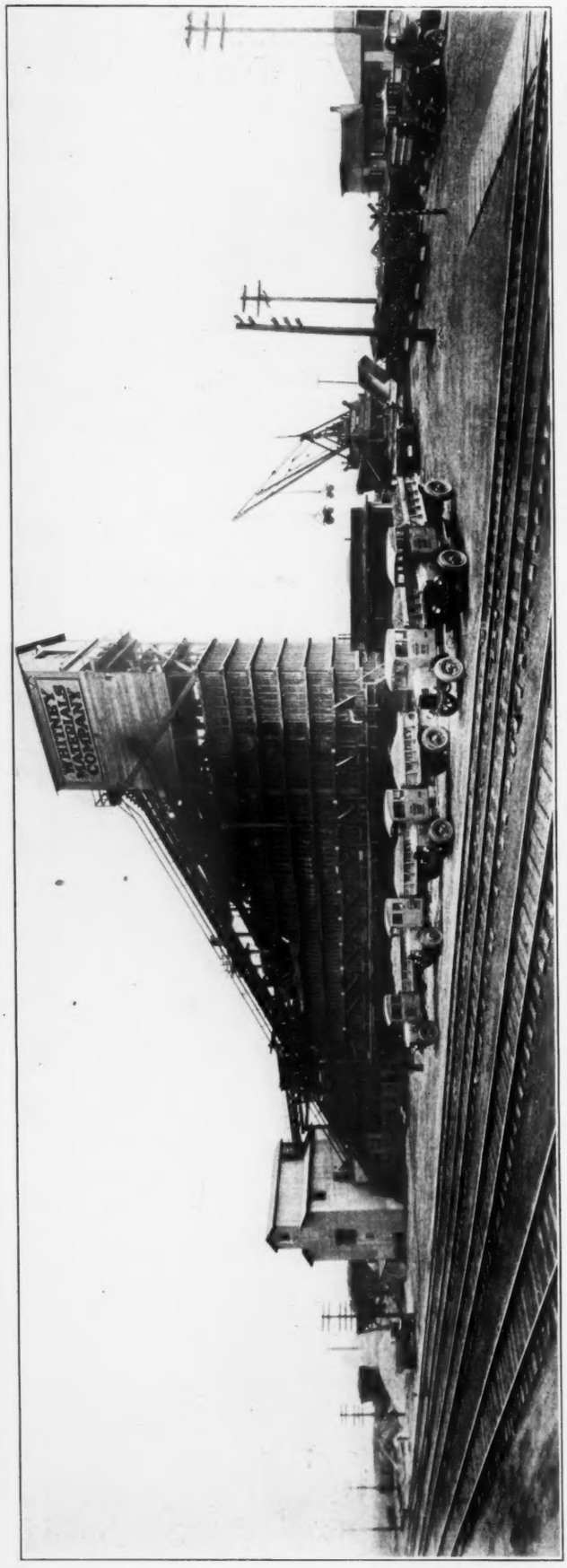


Diagram Layout of Whitney Materials Company Operations



Flow of Material Through the Plant. Letters "B" and "H" Identify Belts Referred to in the Article.

Looking Down the Incline Showing Dual Equipment



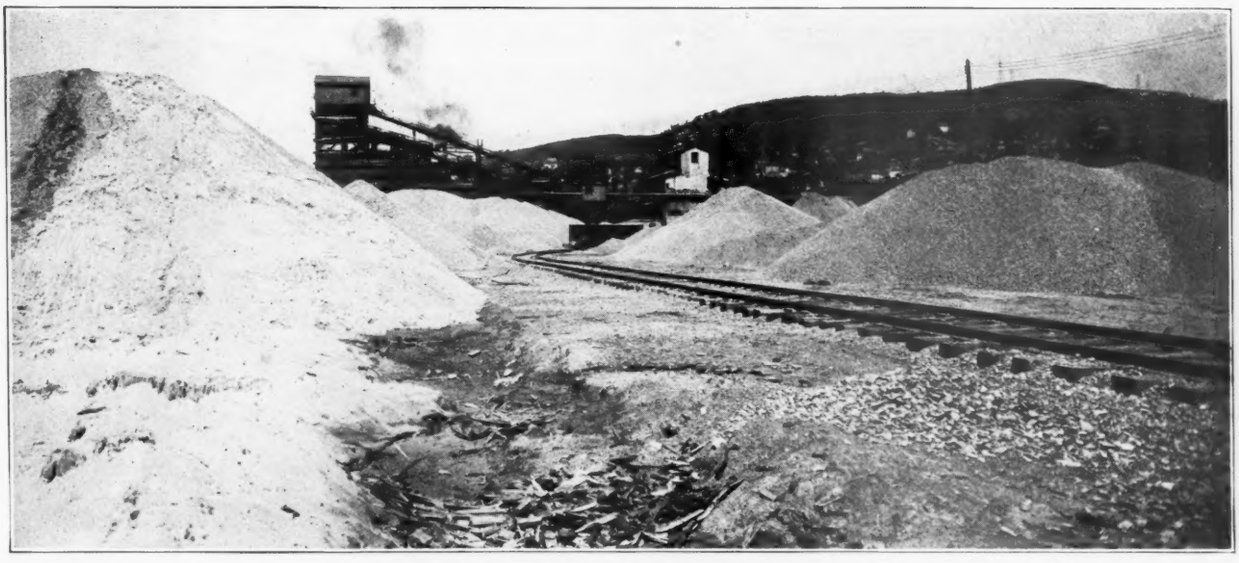
Front View of Screening Plant Showing Double Derrick Scow in the Background Unloading Raw Materials. Trucks and Trailers at the Right. Retail Bins at Left.

ment in repair, and also for building pile drivers and other heavy equipment used by them in their contracting operations.

Three trains, each consisting of a 5-ton truck and two trailers, are used for hauling materials down from the Boulevard Pit. Two of the trucks are Macks and the other a White. All are equipped with 3-way dump bodies having automatic dropping sides, which are a product of the Differential Steel Car Company. With side-dump trailers, the train dumps its load of 17 cubic yards into the receiving pit at the screening plant, to either side without uncoupling, and the trucks, when not pulling the trailers, dump to the rear if desired. The trailers, which are a product of the Trailmobile Company, have two three-yard tubs built by the Lee Body Company, mounted on a four-wheel 10-ton chassis equipped with 4-wheel metal to metal Westinghouse air brakes. This equipment with air brakes on the truck gives the truck driver perfect control at all times, even when descending grades as steep as 17 to 18 per cent.

In designing the screening plant, which was done by engineers within the organization of Whitney Brothers Company, flexibility was the key note—commencing with the handling of raw materials received at the plant and continuing throughout all operations until the customer has been supplied with any size and any grading of materials desired. This applies to sand and gravel separately, or in batches of any proportions required.

Into the receiving pit is dumped material brought down by the trucks and trailers from the Boulevard Pit, together with the material brought in by scows which is stock piled on the dock and transported to the receiving pit in a specially designed dump car. The capacity of this dump car is twenty-five cubic yards, and it is pulled by an electric-driven double drum hoist of their own design and make. From the receiving pit the material is moved to belt "B" by a 42-inch Link-Belt apron feeder, 16-foot centers, operated at a speed of 20 feet per minute, and driven by a 10 h.p. Westinghouse motor. All belts are 30 inch, 6 ply, one-eighth inch rubber covered. Belt "B" with 175-foot centers, traveling at 265 feet per minute, carries the raw material about half way up the plant and discharges on a rail grizzly, spaced five inches. The over-size material from the grizzly enters a 36x18-inch Farrell jaw crusher. The recommended speed of this crusher is 300 r.p.m., but it is being operated at a speed of 250 r.p.m. The crushed material is discharged onto belt "C," which is 112 foot centers, running at a speed of 160 feet per minute. The materials passing through the rail grizzly fall into a hopper and are fed to belt "C" by a 36-inch Link-Belt pan feeder operated by a 10 h.p. Westinghouse motor with remote control. In this connection, all motors throughout the plant running equipment requiring special atten-

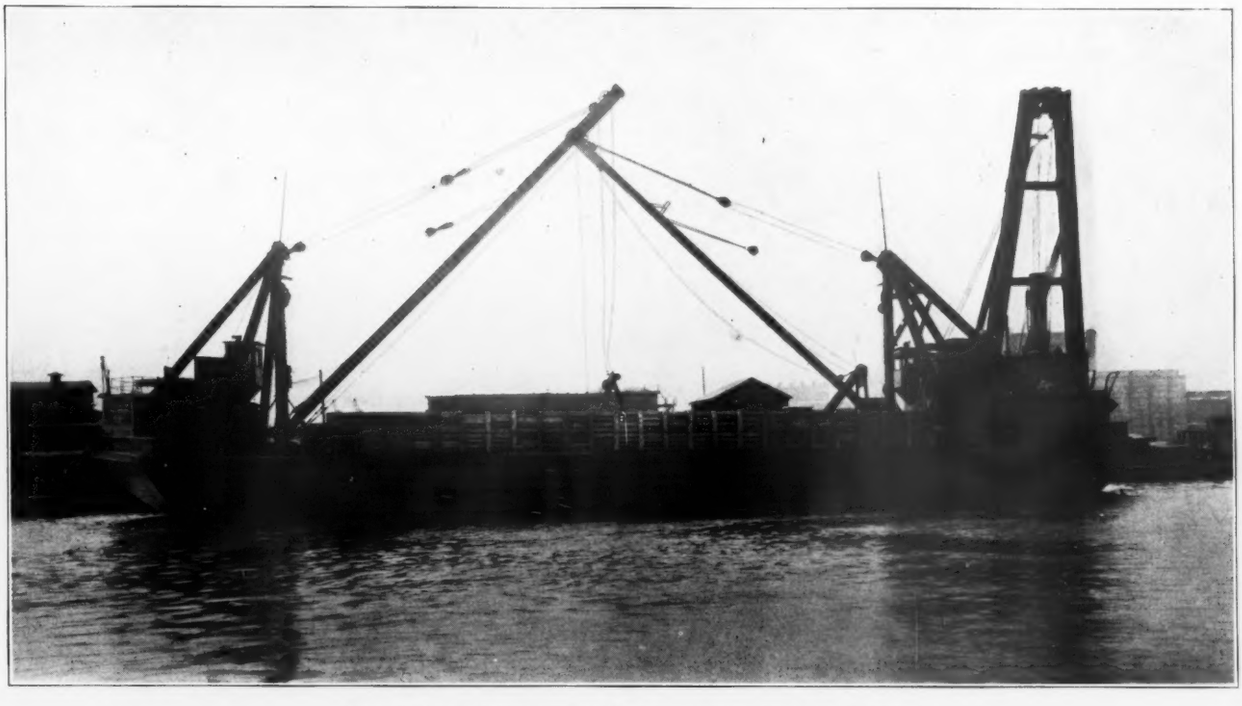


View of Storage Dock. Capacity, 100,000 Cubic Yards.

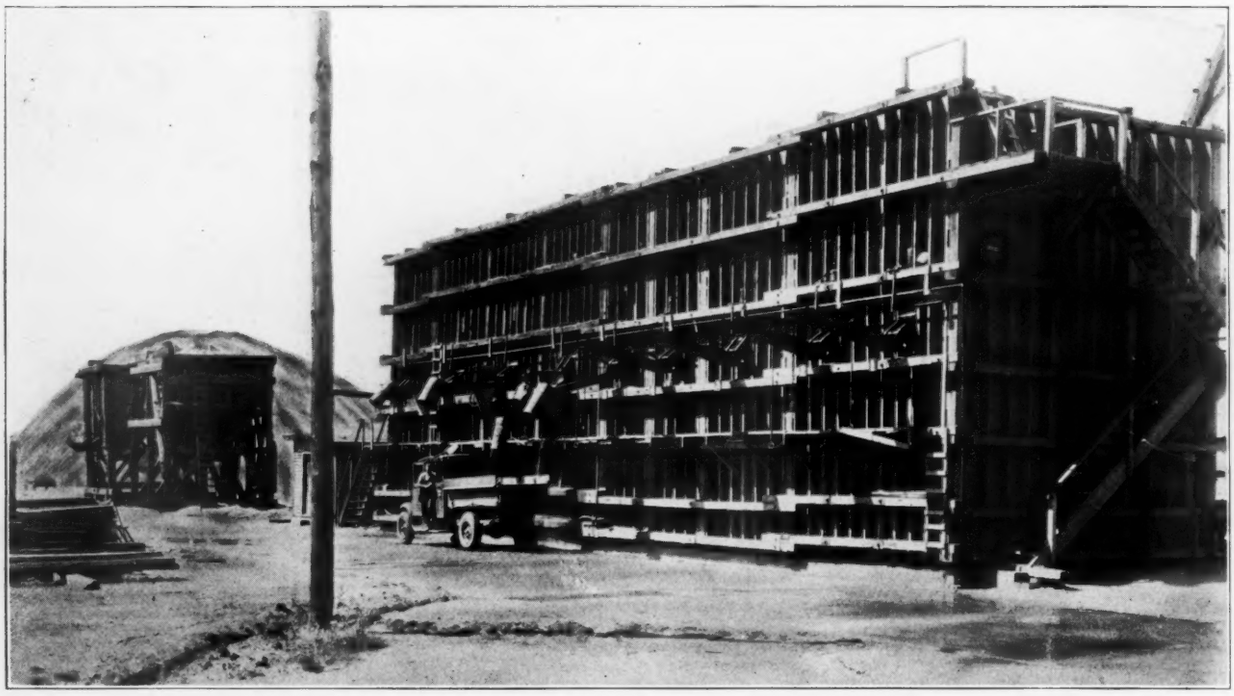
tion have remote control. Belt "C" doubles back and up to a higher elevation, where the materials are discharged through a hopper to belt "D," which is 180-foot centers, running at a speed of 175 feet per minute. Belt "D" reverses the direction of travel, and elevates the material to the scalping screens in the crusher house. The scalping screens, two in number, parallel and alongside of each other, are 4x10 feet, one having 2-inch square mesh, and the other 1 inch. Control of the maximum size material desired in productions is maintained by a gate in the chute serving the scalping screens from belt "D." The entire flow is directed to either the 2-inch or the 1-inch screen. The flow of the materials retained on the scalping screens is distributed between a 6-inch Superior-McCully fine reduction gyratory crusher and an 18-inch x 10-inch Blake jaw crusher, both manufactured by the Allis-Chalmers Manufacturing Company.

The product of these crushers is discharged on to belt "F" and carried to the hopper beneath the grizzly, where it is again fed to belt "C," thereby creating a closed circuit to insure proper reduction of the oversize. Materials passing the scalping screens drop through a hopper on to belt "E," where they are elevated to scrubbers at the top of the plant. Belt "E" is 175 foot centers, running at a speed of 200 feet per minute. The scrubbers, which were designed and manufactured in their own shops, are 8 foot cylinders, 5 feet in diameter, with dividing ribs and veins to accelerate tumbling and agitation of materials.

Dual scrubbers, screens and settling tanks with separate control levers make continuous operation



One of the Three Derrick Scows. Capacity, 1,500 Tons.



Main Distributing Yard at Superior

Loading Trucks that Haul Trailers

possible. Should some repairs or adjustments be necessary on one of the units, it is stopped and repaired or adjusted while the other side of the plant continues to produce. The screen plates furnished by the Cross Engineering Works are assembled to make 4 by 10 foot cylinders. Spiders and frames for mounting were also designed and made in the company's own shop. By means of four sand settling tanks, two of which are Link-Belt and the others Telsmith, it is possible to produce from one to four different gradings of sand. An American Well Works pump direct connected to a 75 h.p. motor supplies fresh water under high pressure to the scrubbers and screens at the rate of 1,500 gallons per minute. Gravel of different sizes is regularly kept separate in the storage bins beneath the screens, and by means of chutes and gates, various sizes may be combined within the storage bins and spouted direct into trucks at the front of the main plant.

One of the Three Lake Towing Tugs Used by the Company

The Whitney Materials Company maintains a fleet of Fageol trucks for making quick delivery on short notice. All trucking within the city limits is based on established zone rates. Their policy of rendering dependable service keeps these trucks busy and it is apparent that the fleet will have to be enlarged within the near future. One of the outstanding features of this modern plant is the provision for drawing accurate percentages of various sizes from the storage bins onto a mixing belt (belt "H") at the rear of the plant which elevates the special graded material to a boom conveyor. This conveyor has a radius of 55 feet and is used for keeping retail bins, batcher plants for paving jobs, and dump cars for stock piling, supplied with both sand and gravel. Material hauled away in trucks is weighed on a Fairbanks scale equipped with a weightograph, which speeds up the recording of accurate weights.

With the advent of water-cement ratio specifica-

One of the Duluth Distributing Yards

Left to Right—E. A. Banister, Secretary-Treasurer; F. G. Wood, Sales Manager; N. A. Valby, Superintendent; E. G. Mortenson, Chief Clerk

tions, the importance of well graded materials is generally recognized in this territory. A laboratory with modern equipment for conducting and plotting screen tests, determining unit weights, moisture content, bulking factors, etc., is a part of the plant, and contractors are able to take full advantage of the service given by this company for determining the ideal grading and desirable characteristics of material for the particular job in hand. The sales and engineerings department of this company are not content with furnishing materials which merely stay within the broad limits of specifications for aggregates. They assist the contractors in determining the essentials for obtaining the most economical concrete, and the screening plant which has a capacity of 1,250 cubic yards in ten hours produces this material of predetermined quality and grading with unfailing accuracy. The personnel of the Whitney Materials Company is composed of Gwin A. Whitney, president; E. A. Banister, secretary and treasurer; F. G. Wood, sales manager; and N. A. Valby, superintendent.

A Most Valuable Publication

W. B. Ewing, president, Adirondack Feldspar Corporation, writes that the new Pit and Quarry is a very big advantage over the former size. "Pit and Quarry is one of the most valuable publications we receive," he adds.

Technical College Men Will Attend Chicago Cement School

From September 6th through the 9th, faculty members of leading engineering colleges and laboratories throughout the United States will attend a school devoted to a study of the recent developments in the production and use of concrete under the management of the Portland Cement Association, which conducts annually a short course in the design and control of concrete mixtures.

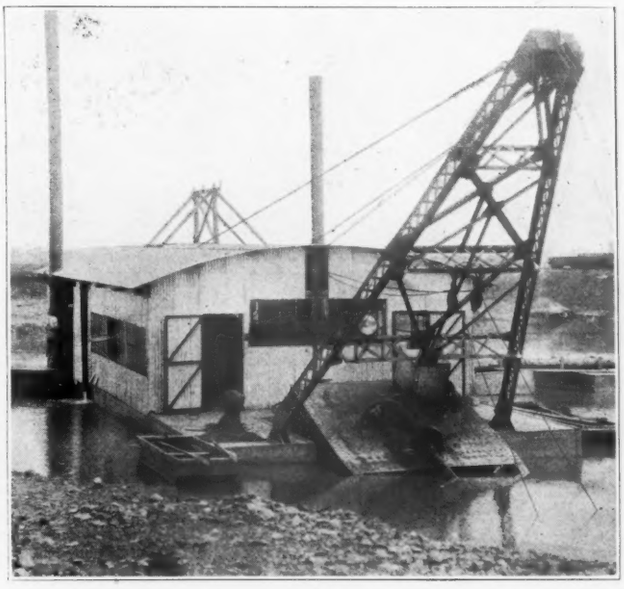
William Kinney, general manager of the Portland Cement Association, in announcing the 1927 course stated: "Sessions will be open only to those engaged in college instruction or research work, so that they may review current developments in the fundamentals of mixture and design and methods of testing concrete and concrete materials. A similar course last year attracted representatives from twenty-five colleges in twenty states. It is expected that attendance will be nearly double this year. Greatest emphasis will be placed on practical application of the water-cement ratio law."

The course for college representatives, besides lectures by prominent engineers and builders on application of the water-cement ratio law, will include daily laboratory sessions and field trips to structural and highway jobs and concrete products plants where advanced methods are employed.

HYDRAULIC PRINCIPLES USED EFFECTIVELY BY GREENVILLE GRAVEL CORPORATION

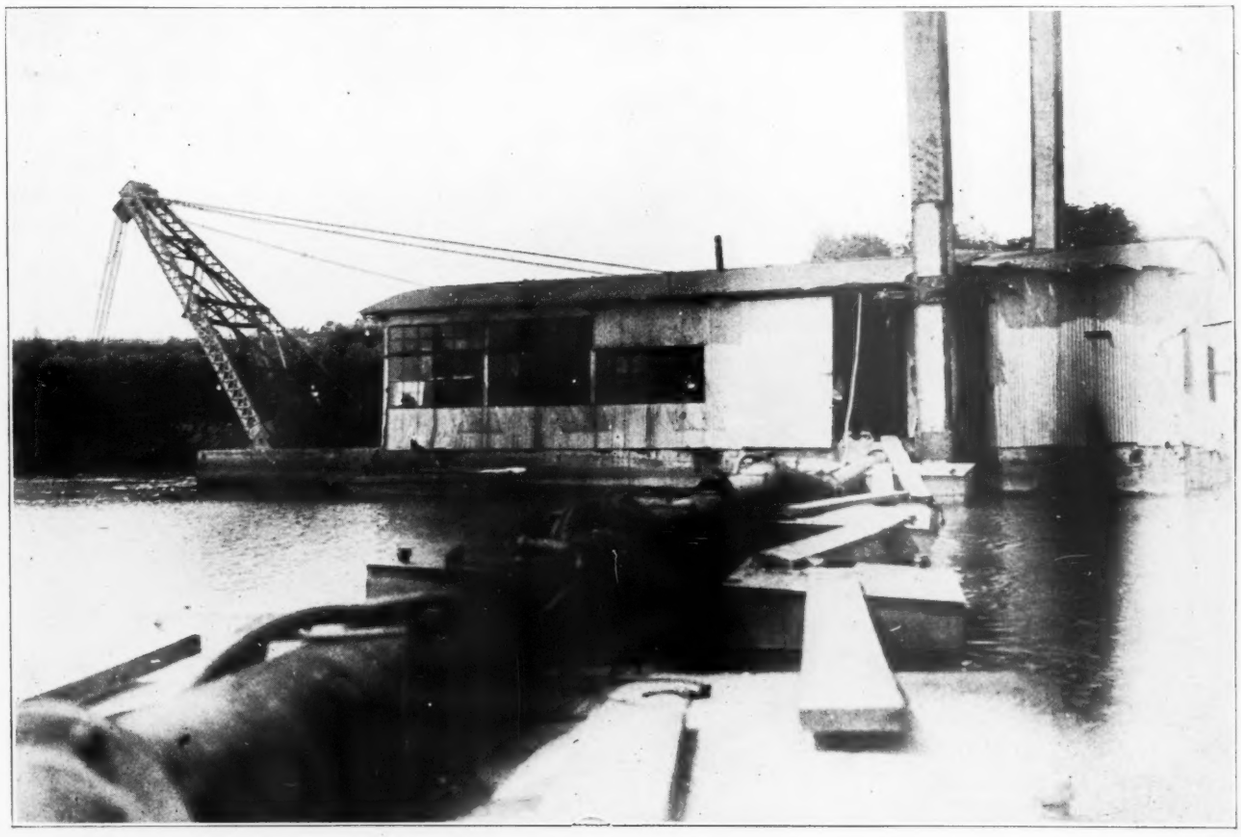
By H. W. Munday

SIXTEEN plants are operated by the Greenville Gravel Corporation, and the combined production of these plants is of such a total as to class this company among the three or four largest producers of sand and gravel in the world. Seven of the plants utilize dredges in producing material. There are two dredging plants in Columbus, Ohio; one at Urbana, Ohio; one at Fort Jefferson, Ohio; one at Logansport, Indiana; and one at Brighton, Michigan. Of these, plant number two at Columbus and the plant at Urbana are the best examples of effective use of hydraulic methods among the plants of the company. It is in connection with these two plants that many unusual and clever ideas are employed. These operations, and also all the other plants, are efficient from an engineering standpoint and economical from a production standpoint. It is quite generally known that the Greenville Gravel Corporation has in its organization an engineer of long experience and prominent standing in Frank M. Welch, who as chief engineer is responsible for the design and efficiency of the company's various plants. Mr. Welch has also been connected with many other plants outside the Greenville Gravel Corporation as designer or consulting engineer, some of which he continues to serve in a consulting capacity.

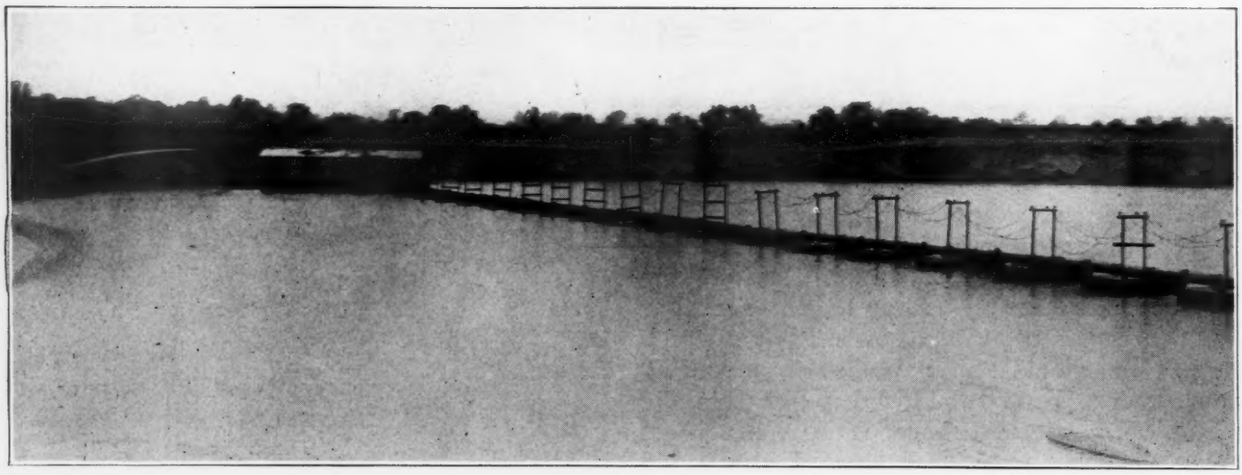


Dredge at Plant Number Two—Columbus

Plant number two at Columbus, Ohio, is the most notable of the plants operated by the Greenville Gravel Corporation. It is the latest, going



Showing Side Discharge and Side Spuds at Plant Number Two, Columbus

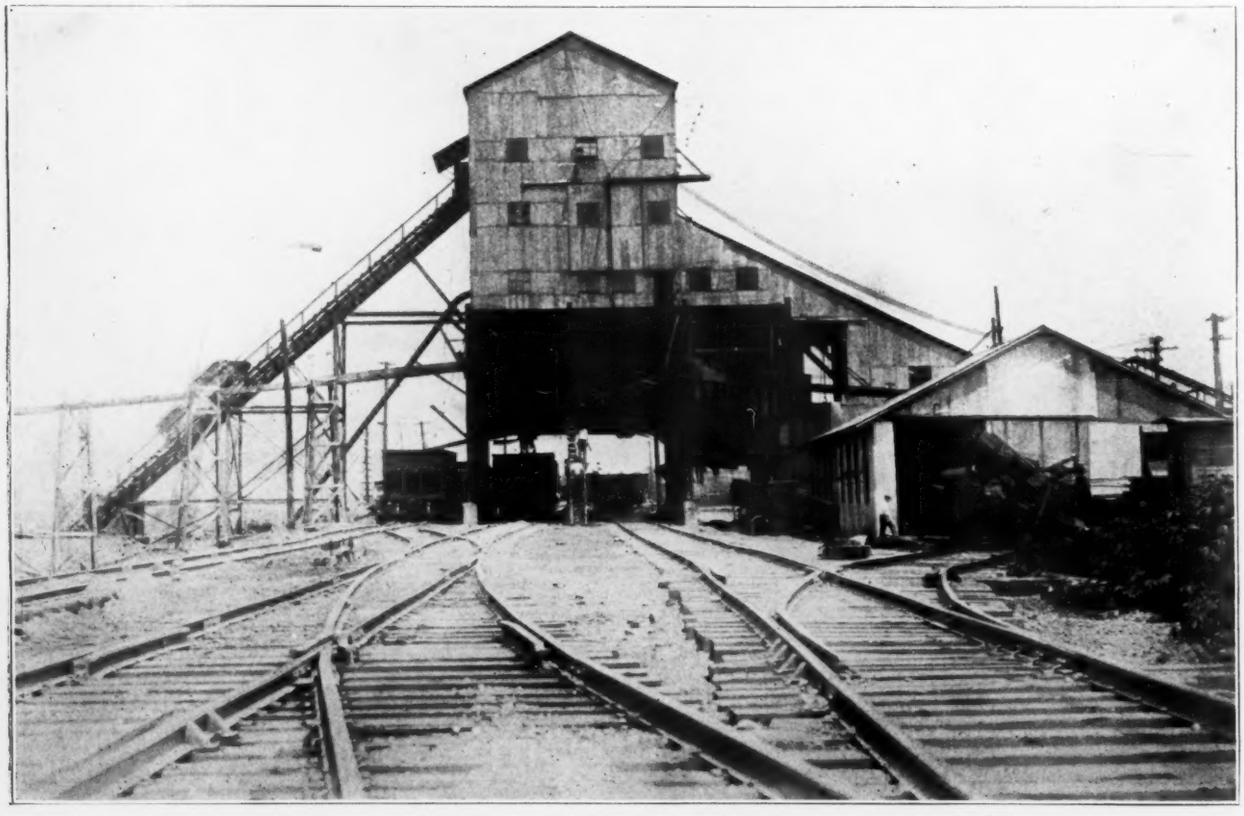


Dredge and Pipeline at Urbana

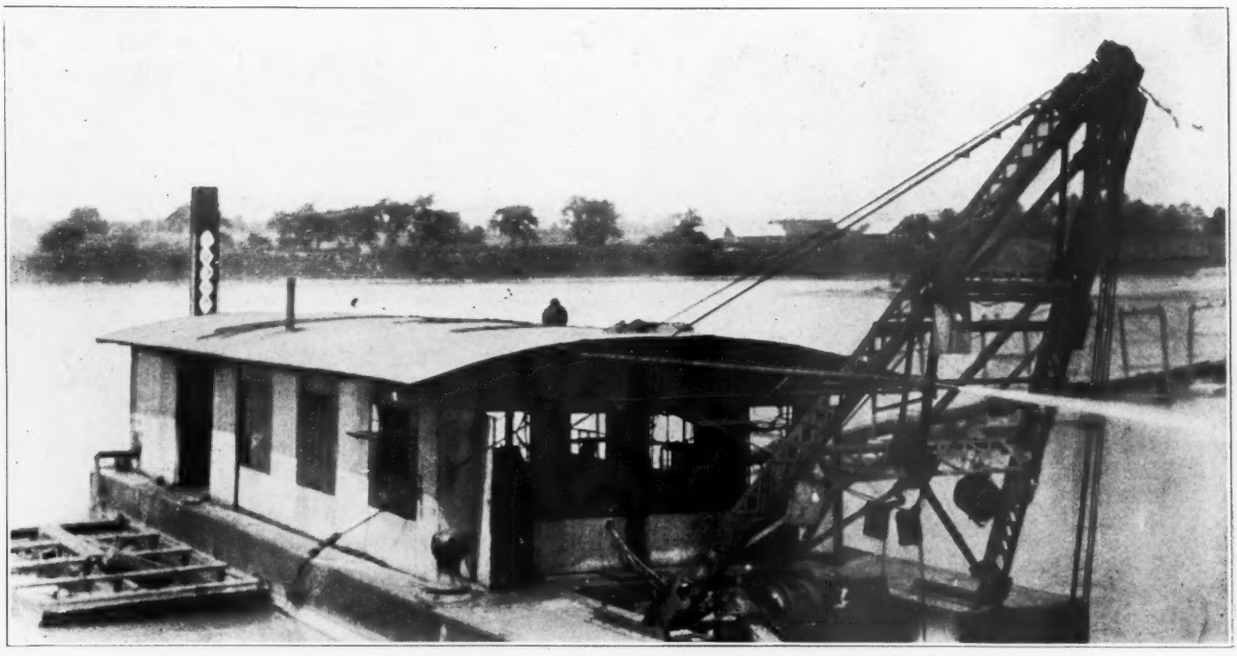
into production in 1926. The unit as it stands today is a smooth running plant producing 4,000 tons per shift. Twenty-five men, with a few extra occasionally, produce an average of 7,000 tons a day. Material handling has been reduced to a minimum. The dredge is particularly well designed as will be explained later. The method of handling the dredge discharge, both at this plant and at Urbana, is unusual and original with F. D. Coppock, president of the Greenville Gravel Corporation. The dredge and the screening, crushing and storage building are of steel construction.

The plant is located only two miles from the heart of Columbus. The deposit covers 240 acres and lies close to the Scioto River. The overburden averages five feet. The the present time there are about seven feet of bank above water. Good gravel runs from 25 to 40 feet on the north and to as much as 60 feet toward the south of the deposit. A little more than five acres of the deposit is now under water. The deposit is straight and solidly packed. It runs 40 per cent sand and about 20 per cent boulders.

The all steel dredge, built in the shops of the Greenville Gravel Corporation, has a hull 66 feet long, 26 feet wide and 5 feet deep. It carries a 15 inch Amsco pump direct connected to a 400 h.p. General Electric motor for excavating. A 4 inch Worthington pump is used for priming. A five drum Lidgerwood hoist is mounted on the deck of the dredge and is driven by a 25 h.p. General Electric motor and handles a manganese steel rotary



Plant Number Two at Columbus. Incline With Cable Car Shown at Left

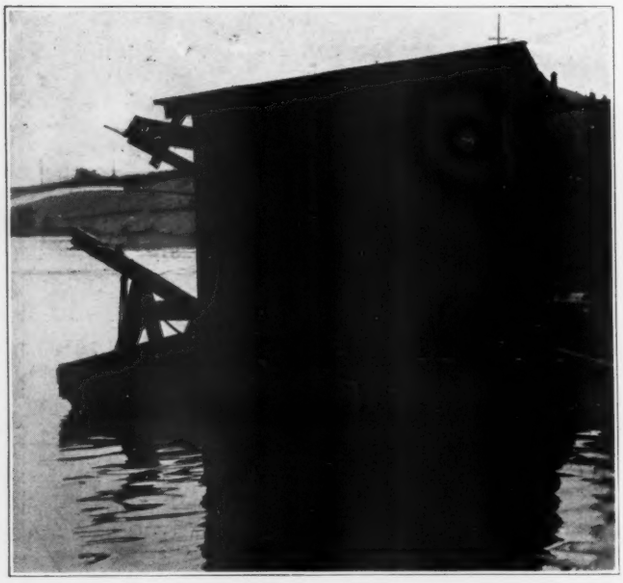


Side Discharge Rear Spud Dredge at Urbana

cutter carried by a 50 foot ladder. The dredge sides and roof are of Armco ingot iron with one seam in the side sheets and one seam in the bulk heads. Two spuds are used, one on each side. The discharge is from the side. Side spuds and side discharge are not common in dredging operations. The advantage of this layout is that the pivot is at the discharge, eliminating play in the length of pipe. The pumping position is nearly straight. The deposit is being worked in a semi-circle. Operations are carried on so that one length of pipe makes a clear sweep of the semi-circle.

The pipe line from the dredge is pretty straight and is carried by 10 steel pontoons each 6 by 12 feet. U. S. Rubber sleeves are used. The suction hose is also a U. S. Rubber Company product. The sections of pipe are numbered so that as you walk over the line the dates are a reminder of the date when a particular pipe was turned. Each dredge pipe section here is turned about every five weeks. The pipe line discharges to a sump over a concrete tunnel. Five ton cable cars are dropped below the tunnel and loaded through gates two feet below the normal water level. Two cable cars are used. While one is being loaded, the other is discharging. They are hauled up an incline of 40 degrees and discharged to 25 ton hoppers that feed the main washing screens by a 100 h.p. Lidgerwood double drum hoist equipped with Leschen wire rope. Curtis air hoists supplies by an Ingersoll Rand Compressor operate the two discharge gates loading the cable cars. A man in the tunnel handling the air hoists signals for hauling up the cars. The tunnel in reality is a steel tank 32 by 18 by 8

Crushing, Screening and Storage Plant at Urbana



A Pump is Mounted on This Floating House at Plant Number One, Columbus

feet. The double track skipway is built of structural steel with concrete foundations.

The material is fed from the hopper to either of two 60 inch main washing screens. Each screen is 22 feet long and has three jackets. They were made in the shops of the Greenville Gravel Corporation and have Cross Engineering perforated plates. These gravel screens are equipped with rollers to keep the screens from clogging. The outer jacket on both screens has 3/4 by 1/4 inch slots. The inner jackets have 5/8 inch holes. The main section has 1 3/4 inch holes. Material over 1 3/4 inch passes by chute to a grizzly. Material passing the outer jacket passes to a 60 inch vibrating sand screen equipped with Tyler screen cloth. This sand screen is equipped with brushes to keep it from clogging. The other sizes produced by these screens go to bins. Water is supplied for washing by two 8 inch DeLaval pumps with a capacity of 4,000 gallons per minute and operated by 60 h.p. General Electric motors.

Material over 1 3/4 inch passes to a grizzly and is handled by four crushers. The oversize is taken by a number 6N Allis Chalmers crusher. The sizes passing the grizzly are divided between a 6 inch McCully and a 4 foot Symons cone crusher. All crushed material is elevated by a common elevator 60 foot centers to a 60 inch stone screen. The rejects from this stone screen are passed to a 36 inch Symons disc crusher. The Allis Chalmers and the McCully crushers are operated by a 100 h.p. General Electric motor. The Symons cone crusher is operated by a 75 h.p. General Electric motor, while the Symons disc is operated by a 40 h.p. General Electric motor.

Material is loaded into both railroad cars and trucks. The bins are wood lined with steel framework. There are five bins for loading cars and seven for loading trucks, providing storage for about 700 tons. A Fairbanks scale is used for weighing trucks. The track arrangement shown in one of the illustrations explains the excellent loading facilities.

A Marion Model 36 with a 50 foot boom and a 1 1/2 yard Page bucket is used in stripping. This machine discharges to a movable floating flume that dumps the material 80 feet from shore. An 8 inch DeLaval pump is used in washing the material down the flume. A 175 Bucyrus with an 105 foot boom and a 5 yard Page bucket is being used to load sand and gravel into Western dump cars. These cars are hauled by a Vulcan locomotive to the plant.

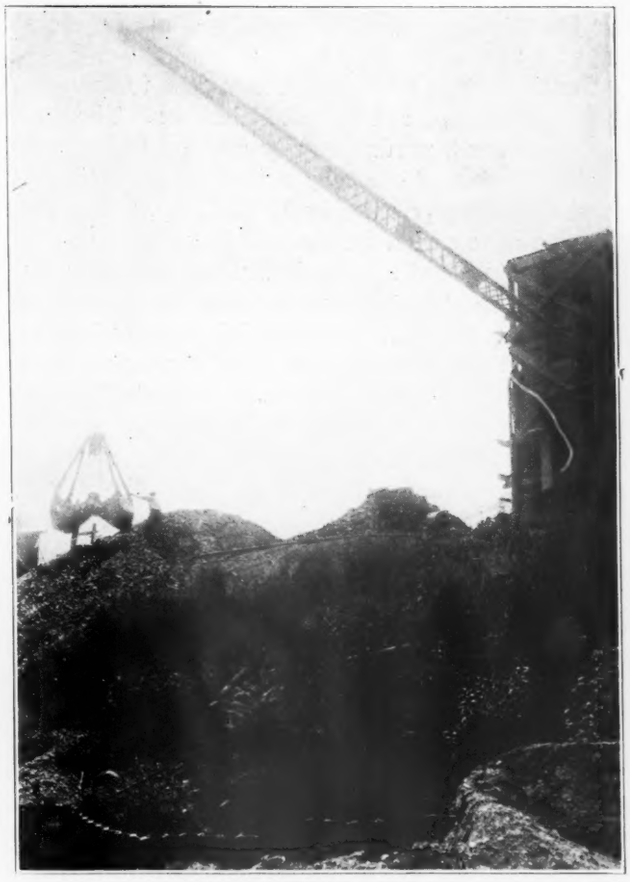
Whenever necessary throughout the plant are

Dredge For Plant Number One at Columbus

seen Yale and Towne or Harrington chain block hoists for lifting units for repairs or inspection. A Caterpillar tractor is used around the plant for a multitude of jobs which keep it busy nearly all the time.

Some important developments are under way at this plant. A tipple is being installed for truck loading only 1½ blocks from High Street, a main artery of Columbus. A side track will be built for direct loading to the New York Central Railroad. Present shipments are made over the Hocking Valley with switching arrangements with all roads passing out of Columbus. A concrete products plant will be built.

Plant number one has been in operation for years. This plant is on the Scioto River and operates under a franchise from the city to widen the river. The dredge is equipped with a 12 inch Amsco pump operated by a 350 h.p. Westinghouse motor. A five drum Lidgerwood hoist operates the suction line. The pipe line discharges to a sump where a stiff leg derrick equipped with a 1½ Owens clamshell bucket elevates the material to the plant. A three drum Thomas hoist operates the derrick. This plant is equipped with four Link Belt conical screens and a Link Belt sand separator. A number 5 Austin and a number 3 Allis Chalmers handle the crusher. At present, this plant is producing 1,000 tons a day, and the larger portion of this is delivered by trucks. A Plymouth gasolene locomotive is used in switching railroad cars.



Clamshell Derrick and Sump at Plant Number One

At Urbana, Ohio, we find another plant similar to plant number two at Columbus. The dredge at Urbana has a side discharge but only one spud and that is the rear. A stream of water is used to break up the bank here, while none is used at Columbus. A 15 inch Amsco pump is used in excavating. The suction line runs under the deck of this dredge, while it was on the deck at Columbus. An American hoist operates the suction line. Twenty men produce an average of 350 tons per hour at this plant.

Twenty-four 6 by 12 feet steel pontoons carry 500 feet of 16 inch pipe to shore, and the remaining 220 feet are carried on bucks. This pipe at present is unusually straight. There are only seven flexi-

Dredge With Plant in Background at Urbana

ble joints next to the dredge and one at the water's edge.

The discharge from the dredge pipe to the sump is practically the same as at Columbus. The cable cars here are 3 yards capacity and are hauled up a similar incline 185 feet by a Lidgerwood hoist. A number 5 Gates, a number 10 McCully, a four foot Symons cone and a number 37 Kennedy comprise the crushing unit. Three bucket elevators are necessary in the material handing system. They elevate the ¼ inch, the material to the vibrating screen and the crushed stone. All chutes are lined with steel. The plant is completely electrified with General Electric motors. The dredge, screens, chutes, elevators, cable cars, belting, etc., were all manufactured in the shops of the Greenville Gravel Corporation.

P. S. Klyne manages plant number two at Columbus; J. J. Corcoran, plant number one, and E. E. Mills, the plant at Urbana. All three men are veterans of long standing in the sand and gravel industry. F. D. Coppock is president of the Greenville Gravel Corporation and all its subsidiaries. C. E. Patty is vice-president and general manager. Guy C. Baker is sales manager; H. R. Brown is secretary-treasurer; Joseph F. Coppock is general superintendent and F. M. Welch is chief engineer. The total output of plants will exceed 7,000,000 tons this year.

Lime Needed in Winter Diet of Pigs

Experiments conducted by the Ohio Agricultural Experiment Station and reported in their May-June, 1927, Bi-monthly Bulletin, show that pigs quickly develop physical weaknesses when their feed lacks certain minerals and vitamins. Fifty-six pigs were used in the experiment, which was conducted over a period of 156 days.

The addition of two pounds of ground limestone to every 100 pounds of grain mixture enabled the pigs to gain 0.34 pound more daily than on the plain grain ration, to save 94 pounds of feed for every 100 pounds increase in live weight and to escape severe stiffness or paralysis as well as lameness during winter "dry lot" conditions. The strength of their bones was also greatly increased by the addition of limestone to their feed. The addition of limestone alone, however, does not make up for the vitamin deficiency of the plain grain diet which must be supplied by butterfat, yellow corn, alfalfa hay or cod-liver oil.

Sulphite Lye Used on Roads

Sprinkling with sulphite lye has been used with success on a road in the vicinity of Stockholm as a means of reducing the cost of upkeep of gravel and macadam roads. The cost of the sulphite lye used in 1924, when the sprinkling commenced on a small scale, amounted to 250 crowns, and in 1926, to 2,373 crowns. This increased expense is, it is claimed, however, more than compensated by the reduced total cost of upkeep, viz.: 11,400 crowns in 1924 and 6,400 crowns in 1926. The amount of gravel used in 1924 and 1926 was 645.5 and 121 cubic meters, respectively, and the amount of macadam, 86 and nil cubic meters, respectively.

Discharge to Sump at Plant Number Two. P. S. Klyne, Plant Manager at Right

CRUSHERS AND THEIR COMPONENT PARTS

By Wm. T. W. Miller

Part IV

PARTS one, two and three of this series of twelve articles appeared in the July 6th, July 20th and August 3rd numbers, respectively. Mechanisms applied to jaw crushers was the main theme of the first article while in the second article jaws and cheek plates for rock crushers were treated in detail. In his third article Mr. Miller took up the subject of toggles and toggle bearings and in the following installment his theme is the lubrication and cooling of jaw crusher bearings. The eight future articles in this series will appear in the ensuing issues of Pit and Quarry.

Mr. Miller, the author of this series, has had thirty years' experience as a specialist in crushing machinery. For the last twenty-six years he has been employed by Hadfields, Ltd., of Sheffield, England. For the past eighteen years he has been engineer-in-charge of their crushing machinery department. He has studied crushing problems in the United States, Canada, Brazil, Uruguay, Argentine, France, Spain and Portugal.—Editor.

Jaw Crusher Bearings
Their Lubrication and Cooling

Crushers of the Blake type, in common with jaw breakers of many other types, are liable to suffer from overheating in the bearings for the eccentric shaft. This trouble increases with the size of the machine, making it advisable, when the feed-opening exceeds 36 by 24 inches, to watercool the upper pitman and the lower frame bearings. The factors which influence the rise in temperature under running conditions are: the load in pounds per square inch on the projected area of the bearing, the rubbing speed of the shaft in feet per minute, the character of the lubrication and the nature of the bearing metals which decides the coefficient of friction.

The load in pounds per square inch on the frame bearings is made up of two parts: the dead load due to the weight of flywheels and shaft and in most cases the pitman and part of the weight of the toggles, and secondly, the pressure due to the pull on the pitman when transmitting the crushing force during half of each revolution of the driving shaft. The first part of the load can be readily calculated; the second part can only be based on the assumption that the pull on the driving belt is transmitted evenly on a circle whose diameter is equal to the stroke of the eccentric shaft. Actually some portion of the power is absorbed by friction and disseminated as heat.

It is in regard to the second part of the equation that a large margin of error is possible. The power transmitted by the driving belt is not the whole of the force available to meet any sudden demand. The flywheels store a large reserve of energy any portion of which may be disbursed in a variable fraction of time. In addition to this irregular feature the power absorbed by the crusher really consists of a series of impulses from low to high load and the theoretical pitman-pull should be doubled to give anything like the maximum working pressure.

The proportions of the various machines will cover a wide range, but, for the purpose of argument, it may be taken that the dead-weight load on the side-frame bearings is equivalent to 50 to 60 pounds per square inch, to which must be added a further pressure of 100 to 140 pounds to include the reaction from the crushing stroke once per revolution. It will therefore be seen that the total mean pressure per square inch on the bearings may vary from 150 to 200 pounds, the momentary pressure due to shocks and peak loads reaching two or three times these figures.

The rubbing or surface speed of the shaft varies to some extent owing to the fact that it is usual to run the eccentric shaft at a fairly constant number of revolutions per minute through a considerable range of different sizes of machines. In breakers with feed-openings from 10 by 6 inches up to 36 by 24 inches the speed is practically constant between 250 and 275 r.p.m. although there is a large variation in the diameters of the shafts.

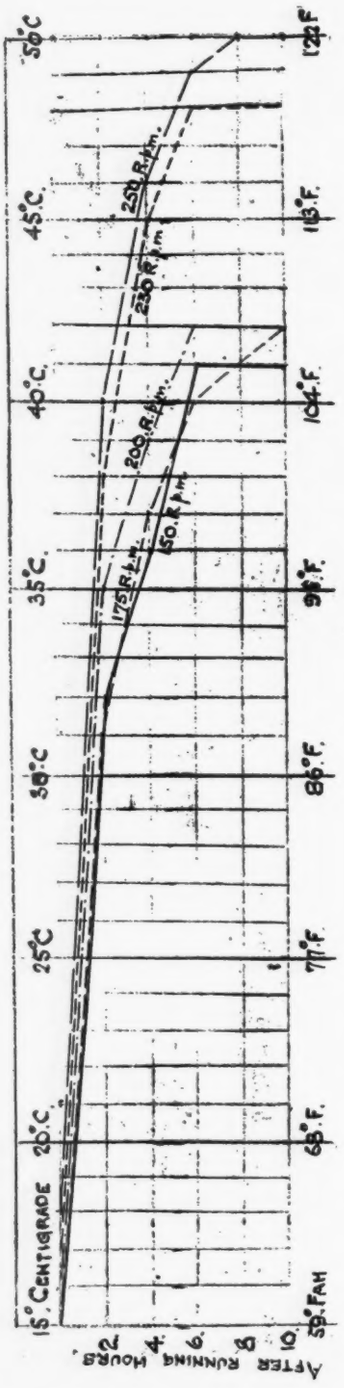
The following table illustrates this point:

Feed Opening	R.P.M.	Shaft Diameters		Rubbing Speeds F.P.M.		Variation in Velocity on Eccentric F.P.M.
		Frame	Pitman	Frame	Pitman Max.	
20"x12"	275	5¼"	7½"	378	540	162
36"x24"	250	9½"	11½"	622	752	130
54"x42"	150	14 "	17 "	550	667	117
84"x60"	85	20 "	24 "	444	534	90

From the foregoing remarks it will be evident that the rubbing speed is on the high side for bearings which are subjected to spasmodic pressures approaching the figures mentioned and which are generally only imperfectly lubricated. Since the frictional surfaces are large, heat must be generated to a greater or lesser extent dependent on the condition of the bearings and unless this heat can be dissipated by radiation as quickly as it is generated the cumulative effect becomes serious after a run of any duration.

As an illustration of this cumulative rise in tem-

perature and as showing the effect of advancing speed on the rate of increase the following records of five tests each of ten hours duration are interesting.



These readings were taken on the pitman and it is this bearing which usually heats up quickest even though the load per square inch of area may be less than in the frame bearings. The rubbing speed at the high part of the eccentric is greater than on the remainder of the shaft but this would hardly seem sufficient to account for so pronounced a tendency to rise in temperature. The writer is of the opinion that the variation in circumferential speed due to the eccentric revolving on a false axis is largely responsible for the extra friction. The rubbing speed changes from a maximum to a minimum once per revolution and the alteration in the surface velocity is made under pressure of contact. The earlier table includes a column showing the extent of variation in a standard series of breakers.

There is one other factor which has a detrimental effect on the pitman and that is the difficulty of ensuring perfect alignment in the parts forming the toggle system, with the result that the load may be transmitted to the bearing very unevenly, causing local heating which quickly spreads over the whole surface. The character of the bearing-metal has a very important influence on the heat generated in service. In the smaller breakers brass or bronze is sometimes used but this material is not the best for bearings in a dusty or gritty atmosphere and the shaft journals become badly scored, making it difficult to bed new bearings to their work.

Babbitt metal in many grades is the material most commonly used. In the smaller machines a lead-base metal will be found sufficient for the work but in the large breakers nothing but the highest quality tin-base metal will meet the conditions. Either oil or grease may be used for lubrication. The former will usually be found rather wasteful in large machines as an ample supply is necessary to ensure adequate lubrication. Grease possesses several advantages. The extruded lubricant forms a sealing ring round the ends of the bearings, helping to exclude the dust, and as the temperature rises the grease melts at a quicker rate, increasing the supply to meet the demand.

With regard to the design of the bearings it may be said that, except in very small machines, the practice of running babbitt metal into cavities in the side-frames to form the bearings has been practically discarded and renewable half-casings are now fitted in almost every instance. These renewable liners may be made in various styles and patterns; any form of loose pedestal-bearing may be said to be suitable for the work. When brass is the metal chosen the half-bearing is usually turned outside with semicircular end-flanges and with a peg or stop-piece in the center to prevent rotation. The earlier form of a half-hexagon or octagon step is still to be found in a few old-fashioned machines. More commonly the semicircular half-bearing consists of a thin shell or casing cast in iron, steel, or brass, machined outside on the bedding surface and lined with white metal. By keeping a set of spare casings it is possible to reline the old bearings at leisure instead of making this a rush job when urgent repairs are in hand.

It will be noted that the above remarks have reference to the bottom half frame-bearing only. In all Blake-motion crushers the work-pressure is almost entirely in the downward direction and, except in the case of a badly designed drive when a

tight belt may exercise a side-pull on the bearings, the upper semicircle in the cap has no work to do other than to exclude the dust. It is therefore very unusual, and should be entirely unnecessary, to fit loose casings in the frame-caps, and a thin lining of babbitt metal is all that is required so that, in case the cap is bolted down too tight, the shaft is not "scored" by contact with the casting.

The pitman bearings usually partake of the same character as the frame bearings except that it is still common, when Babbitt is used, for the metal to be run direct into prepared recesses in the castings. There is a decided gain, however, in adopting the same system as that applied to the side-bearings, and loose casings can be fitted at slight extra expense which will be quickly repaid when repairs are undertaken.

In this case also the pressure is all in the one direction, downwards, and it is really unnecessary, in many instances, to have a loose bottom casing in the pitman as the wear is concentrated in the upper half. The one exception to this rule is a spring-supported pitman where there is some tendency to carry more than the deadweight of the parts, with the result that the upward lift must be controlled, but, in such instances, the area covered with white-metal in the lower half need be only a fraction of that in the upper bearing. On several occasions, where a bottom half casing has been fitted in the pitman to act as a dust-guard it has been discarded by the mine-mechanic as a nuisance and the machine has been kept at work with an air-gap below the eccentric.

For artificial cooling purposes water is the medium most frequently adopted but occasionally compressed air is forced through the bearings. Air-inlet holes are drilled in suitable position and the supply taken from the mains furnishing air to the rock drills.

When it is necessary to apply water-cooling the design of the loose casings becomes more complicated. Fig. 1 illustrates the system of chambers in the side-frame bearings. By a suitable arrangement of cores the water is made to circulate from side to side in a zigzag course to ensure a regular flow from one end to the other. It is advisable to insert a drain-pipe and plug in the lowest part of each side-frame casing to allow the water to be drained away in case of heavy frost.

There are several methods of applying cooling-water to the pitman, the most primitive being a perforated pipe fitted lengthwise above the pitman so that the water drips on the outside of the head casting, the surplus draining into a sump in the foundation. The amount of water which can be effectively applied in this way is very small, and with the advent of the larger breakers a more ample supply was essential. In Fig. 2 the pitman head is formed into chambers but in this design the hard sand pockets are liable to cause cooling strains when the casting is made in steel and it is also extremely difficult to clean out the cores.

The pitman-cap in Fig. 3 is made with an open-box top closed by a cast iron cover secured by set-screws. By carrying cross-ribs from side to side of the box with holes through to ensure circulation of the water this deep container is made a source of additional strength to the pitman head. The increase in the radiating surface in contact with the water adds greatly to the cooling efficiency.

The loose-cover construction makes a simpler and stronger casting than that shown in Fig 2, and it has the additional advantage that the cover-screws can be made sufficiently weak to break should the water freeze suddenly. In some instances the pitman is fitted with a chambered casing of the type illustrated in Fig. 1. This brings the water closer to the bearing surface in contact with the shaft, making it more efficacious in case of rapid heating, but it also increases the size and weight of the pitman cap. When the water chambers are formed in the pitman head the bearing proper may consist either of a loose casing lined with babbitt as in Fig. 2, or of white metal run into the pitman cap as in Fig. 3. Although the former type has advantages from the renewal point of view it must be admitted that the latter brings the water closer to its work.

The life of the bearings is greatly affected by the method of lubrication. For many years the size of the crushers was limited by the fact that the rock or ore was always man-handled in the quarry or the mine and the pieces fed to the breakers were not of a size to warrant the use of large and heavy machines. Oil or grease boxes were cast on the caps in these small machines and short pipes with wick feeds, as shown in Fig. 4, were considered sufficient to supply a somewhat irregular quantity of oil to the bearings. For the alternative, large diameter holes carried the grease from box to bearing.

Some engineers, when using oil, preferred sight-feed lubricators, but the rapid oscillations of the pitman made the refilling of the cups on this bearing a very wasteful proceeding unless the machine was stopped for the purpose, which was not always convenient. To overcome this difficulty the sight-feed lubricators were fitted in a stationary frame of sufficient width and depth to entirely protect the pitman head from falling dust and short pipes were arranged to drip into open oil-wells in the pitman cap, as shown in Fig. 5, the wells being made of sufficient size to allow for the oscillations of the pitman.

With a cover-plate of ample width kept as close as working clearances would permit it was found that no appreciable amount of dust made its way into the oil-wells, and, the lubricators being stationary, they held the oil better and could be refilled

Fig. 1.

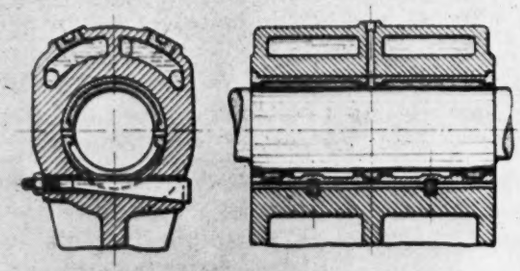


Fig. 2.

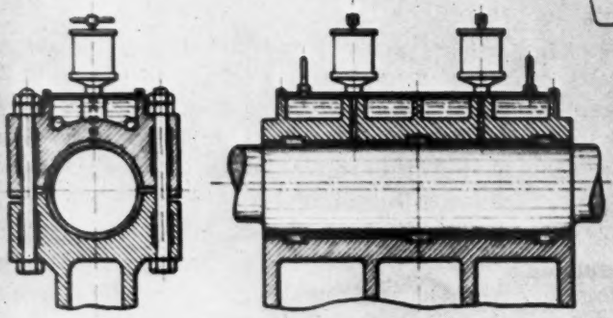


Fig. 3.

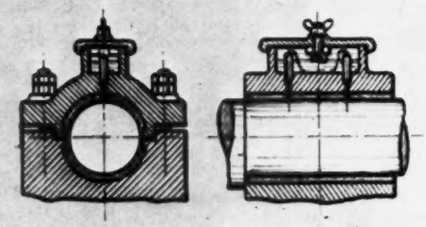


Fig. 4.

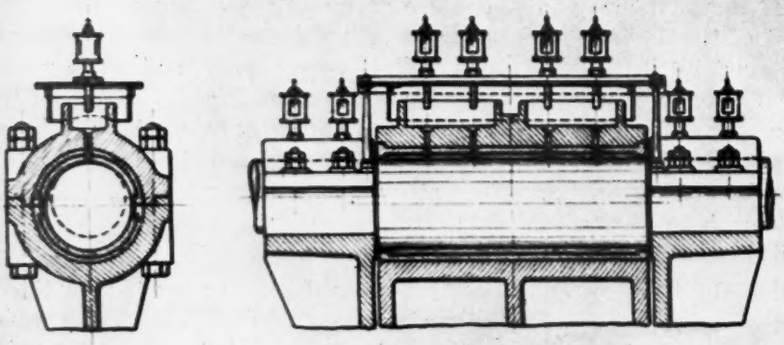


Fig. 5.

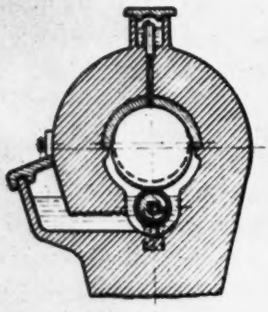


Fig. 6.

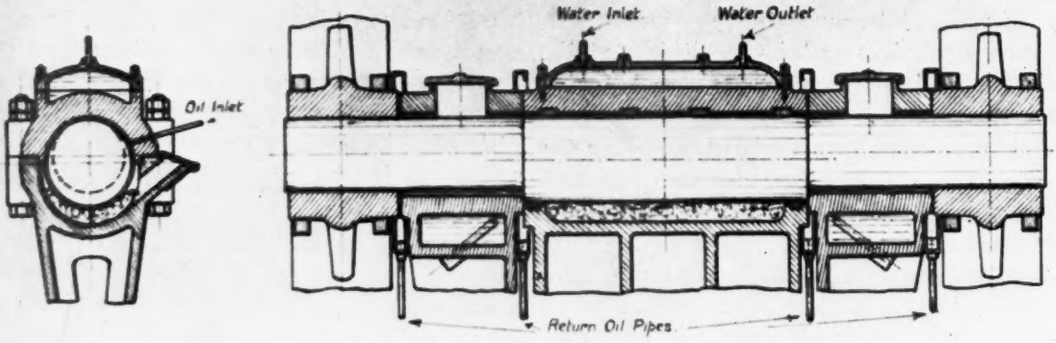


Fig. 7.

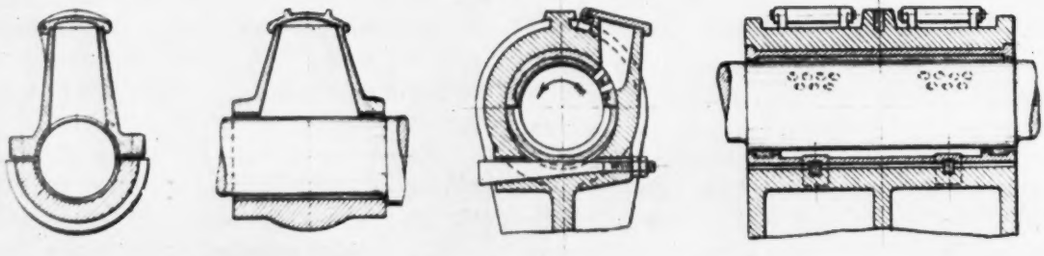


Fig. 8.

Fig. 9.

at any time without spilling. Continuous lubrication from oil-wells by means of loose rings or fast collars on the shaft has been favored by some users of jaw crushers. The writer has known breakers from 24 by 13 inches up to 55 by 30 inches constructed for this system of lubrication.

In the larger machines the frames were designed with sole-plate seatings to receive standard ring-oiling pedestals of large size. In the smaller breakers the oil-wells were formed in the casting of the frame. The system as applied to the frame-bearing worked quite well when reasonable care was taken to see that the felt sealing-rings were kept in good condition, but the results with the pitman bearings were not so satisfactory. The continuous oscillations caused the oil to splash out of the well and the loose ring gave trouble with the result that the pitmen were, in most cases, changed over to grease lubrication.

The pitman bearing is the most awkward to lubricate and the most wasteful of oil. The fact that the oil usually enters the bearing close to the line of greatest pressure makes it difficult to ensure the spreading of the lubricant over the whole surface of the shaft and the oil is quickly dragged round by the shaft and finds its way along the clearance cavity between the shaft and lower casing and escapes through the open ends.

In some machines the lower half-bearing for the pitman is made in the form of an oil-well with narrow strips of babbitt metal to seal the ends and make contact with the shaft. When the well becomes filled with oil from the upper bearings, the swinging movement creates a splash lubrication for the shaft which supplements the supply passing through the oil-holes in the upper casing.

The bottom oil-well may be utilized in other ways. In one design the eccentric portion of the shaft is turned down at the ends so that the walls of the shell-casing may be raised to retain the oil at such a level that the lower part of the shaft will be constantly submerged in a bath of oil. No bearing metal is run into this bottom casing, which merely acts as a dust seal and oil bath. This construction is good in theory, but in practice it is difficult to raise the end-walls of the oil well to any appreciable extent without making a substantial addition to the maximum diameter of the eccentric portion of the shaft. To cut grooves into the shaft at the neck of the frame-bearings would be fatal to the life of the shaft under normal working conditions.

The pitman shown in Fig. 6 is one of the older pattern in which the babbitt metal is run directly into the casting. In this instance the oil-well is made of considerable depth and is connected by a through passage to an outer chamber so that the supply may nominally be replenished at frequent intervals. A felt-lined or solid roller journaled in seatings supported by springs is made to contact with the undersurface of the eccentric, thereby maintaining a film of oil for the greater part of the length of the bearing.

The most effective system for supplying oil to the bearing is undoubtedly by means of force-pump lubrication. An ample and generous amount of oil not only helps to reduce the frictional losses to a minimum but it also serves to carry away some of the heat generated by friction. These advantages can only be obtained when the amount of oil passing through the bearings is greatly in excess of the minimum necessary for lubrication, and to make the system economically possible the excess quantity must be collected and returned to the source from which the pump draws its supply.

Unfortunately the design of the bearings and the oscillations of the pitman make it difficult to collect the oil after it has done its work and prevent its contamination in a dusty atmosphere. Oil savers have to be fitted at the ends of the bearings and the castings must be designed to reduce capillary attraction and divert the oil into the appointed channels, from which a service of piping must be laid to an oil tank with a filter to remove any deleterious matter. Fig. 7 shows the arrangement of the bearings with the oil-savers in position. The pump is usually of the plunger variety, operated by a crank-pin or eccentric attached to one end of the main shaft, a series of pipes being coupled to the pump to lead the oil to the lubricating holes, each pipe having its own regulating cock.

This system is somewhat expensive and troublesome to install unless the machine is designed to suit in the first instance, and it is necessary to maintain the connections in good order or serious loss of oil will result, but when correctly fitted and given careful attention it proves to be most economical in oil, power consumption, and durability of bearings. As previously stated, for ordinary working under the rough-and-tumble conditions which appear inseparable from the majority of mine and quarry operations, grease possesses advantages over oil as the lubricant for jaw crusher bearings.

For the smaller breakers compression grease cups of the "stauffer" pattern are usually sufficient for the purpose, but these are better if fitted with some form of spring-plate and telltale to maintain the flow and give warning if the supply becomes deficient. In the big sledging crushers the grease-cups are specially made of sufficient capacity to hold about one day's requirements, and the pitman bearings have usually two sources of supply, the grease being forced from fixed receptacles attached to the frame through flexible pipes to the lower bearings in addition to the system of pressure lubricators screwed into the pitman cap.

Figs. 8 and 9 illustrate other methods for applying grease or heavy oil to the bearings. The large storage chamber in the cap in Fig. 8 is in-

tended to be packed with yarn saturated with light grease or viscous oil. The wool yarn should be twisted in the form of a rope and laid in the corners of the pocket and then packed over the exposed surface of the shaft to prevent undue leakage of the lubricant. It is advisable to break up the yarn at intervals so as to bring new surfaces in contact with the shaft, say every three or four weeks. The pitman head in Fig. 9 is designed for the direct application of heavy grease. The grease is rammed hard into the pockets and pressed down so that it penetrates the holes in the casing, which are sufficiently numerous to ensure proper distribution of the lubricant. The foregoing remarks have been confined to the bearings for the eccentric shaft, and the only other bearings which require lubrication are those for the pivot-pin or shaft carrying the movable jaw.

In many cases the shaft is pressed or fixed in the jawstock and the projecting ends arranged to hang in split bearings in the side-frames, which may be fitted with loose casings of gunmetal or lined with babbitt metal. In a few rare instances the shaft is made a fixture in the frame and the movable jaw is bored and bushed to swing freely on the shaft. The movement is a peculiar one, being so slight as to be hardly noticeable, but the pressure is considerable and difficulty is frequently experienced in getting the lubricant to travel to the pressure point. Cast iron should never be used for the bushes as it tends to crumble under the nidging action of the oscillatory movement, but cast steel or phosphor bronze will be found satisfactory.

Pressure grease-cups are usually fitted and a grease of the consistency of vaseline is the lubricant generally adopted, the grooves cut in the bearings being of ample width and length to traverse the area thoroughly. When the bearings are fitted in the crusher-frame the caps may be chambered out for felt-pad and oil lubrication.

The jaw crusher as the primary unit should be considered one of the most important machines in the series. Continuity of operation of the whole plant may depend, in large measure, on the breaker being kept in good running order. Whilst it must be admitted that the working conditions are almost invariably adverse, this is not sufficient excuse for neglecting the bearings and wasteful lubrication, and, although economy of operation is largely a question of design, much can be done to mitigate the bad conditions by careful attention to details.

Building Trade Wages Reach Peak

Wages of workers in the building trades apparently have reached their peak throughout the country and will remain at a stationary stage although a slight recession in pay rates may occur in some sections during the next six months according to a survey recently completed by the American Bond and Montgage company.

What About Your Saturation Point?

When Ingersoll had finally perfected his watch and was seeking to interest financial backing for his contemplated watch factory, he said: "If I could only turn out one hundred watches a day, I could sell them for $1.00 a piece." "One hundred watches a day!" shouted the astonished banker. "My God, man—where could you sell one nundred watches a day?" "If the price was at one dollar, I could sell them all right," assured Ingersoll. "But, my dear man," interposed the financier, "at the rate of one hundred watches a day you would soon have all the people in the United States supplied with watches—and then what would you do?"

In spite of this early example of the fallacy of talking saturation (at the peak, the Ingersoll watch works turned out 22,000 time pieces a day), economists have continued to establish saturation points with no show of discouragement over the rapid and decisive overthrow of their predictions. In the automotive field particularly have economists continued to set definite figures as the limit of consumption. Whereas fifteen years ago they were talking about a million cars a year, then later, ten millions, they are now fixing the figure at points varying between thirty and thirty-five millions. As a matter of fact, the motor car, like the telephone and the typewriter, will continue to grow so long as it contributes more than it costs to the economic and social welfare of the nation.

Because this is true there can be no definite "saturation point" for automobiles or any other economically sound product. With more than twenty million cars in the United States and with an average life of six years for each car, more than 3,300,000 new machines will be required for annual replacements. This in itself is a neat little nest egg for the automotive industry, and leaves only a possible 1,500,000 new prospects to convert into owners each year to justify the production of 4½ or 5 million cars.

What might be said of the automobile might also be said, in principle, of any other product, be it radio, locomotive cranes, tooth paste, machine tools, shoes, stokers, or diamond rings. It is all a matter of field analysis, then aggressive advertising and sales effort directed toward that field to enlarge consumer acceptance. There lies ahead for any manufacturer a field for development that is limited only by his own capabilities and vision. The man who talks "saturation points" today is unwittingly furnishing humor for tomorrow.

An Undoubted Source of Information

R. P. Doucet, Manager, Asbestos Corporation, Limited, writes: "We wish to congratulate you on the changes you have made in your publication. It is very well illustrated, well written and an undoubted source of information and assistance."

INTIMATE NEWS OF MEN AND PLANTS

Big Universal Portland Boat Completes Maiden Voyage

The biggest boat that ever plowed the Great Lakes, bearing the largest cargo ever carried on the lakes, completed her maiden trip Saturday, July 30, when the steamer Carl D. Bradley nosed her way into the new Buffington Harbor, Indiana, which recently was dedicated by Vice-President Charles G. Dawes. Immediately upon her arrival the new boat began with her own automatic electrical machinery to discharge her own 15,000-ton load of limestone at the rate of a ton a second.

Six hundred and thirty-eight feet long, 65 feet wide, 33 feet deep and costing over a million dollars, the new steel freighter was built specially to carry limestone from the world's largest quarries at Calcite, Mich., to Buffington Harbor at the Chicago plant of the Universal Portland Cement Company, which is one of the few harbors on the Great Lakes deep enough to accommodate this huge new vessel.

Carl D. Bradley, president of the Michigan Limestone and Chemical Company and of the Bradley Transportation Company, for whom the new boat is named, is credited with developing the modern self-unloading type of freighter of which this is the newest example. At the dock when the vessel arrived was a group of officials from Chicago headed by B. F. Affleck, president of the cement company which built and owns the harbor.

Georgia Cement Gets Permit to Enter South Carolina

The Georgia Cement Corporation, according to a report from Augusta, Georgia, has been granted a permit to enter South Carolina with the sale of its securities, and will at once make arrangements to sell stock in that State as well as in Georgia. J. Lee Hankinson, president of the company, is also president of the Augusta Clay Products Company and vice-president of the Georgia-Carolina Brick Company. Definite location of the plant has not yet been decided. The plans tentatively agreed upon provide for the installation of a plant with a 1,000,000 barrel capacity to start with and an additional 500,000 barrel equipment to be added later. It is planned to begin operation just as soon as the first unit of 500,000 barrels capacity is finished and manufacturing will be under way while the second unit is being constructed.

Perrott Made Superintendent of Pittsburgh Station

The appointment of George St. J. Perrott, of North Dakota, as superintendent of the Pittsburgh Experiment Station of the United States Bureau of Mines, Department of Commerce, was announced today. Mr. Perrott succeeds Arno C. Fieldner, recenty promoted to the post of Chief Engineer, Division of Experiment Stations. The Pittsburgh station is the largest of the eleven experiment stations of the Bureau of Mines, and is one of the notably large research institutions of the world.

As superintendent, Mr. Perrott will direct the activities of approximately two hundred scientific, technical and other employees in the conduct of various investigations dealing with safety in mining, the elimination of waste in the mining and metallurgical industries, and the technology of fuels, gases, and explosives. Mr. Perrott, who has been a member of the staff of the Bureau of Mines for the past ten years, has established a reputation as a research specialist in the technology of explosives and in the physcial properties of coal and coke.

The Carl D. Bradley Unloading at Buffington Harbor

Asphalt Paving Conference to be Held at Atlanta

Remarkable progress by the southern states and cities in improved highway and street construction during the past five years will be emphasized at the Sixth Annual Asphalt Paving Conference to be held at Atlanta, Georgia, during the week of November 28th. The First Annual Asphalt Paving Conference was held at the same point in 1922. The sessions will cover paving research, highway engineering, contracting, manufacturers' problems and the economics involved in the vast outlay for streets and highways, and particularly the conservation of existing pavements. The conference will be held under the joint auspices of the Asphalt Association, of which J. S. Helm, Standard Oil Company of New Jersey, is president, and the Association of Asphalt Paving Technologists, of which Hugh W. Skidmore, president of the Chicago Paving Laboratory, is president.

National committees in charge of the various features of the conference are headed by John Klorer, commissioner of public property, New Orleans, for the engineering section; W. A. Hansell, chief, department of construction, Atlanta, as chairman of the local commitee; L. B. West of the West Construction Co., Chattanooga, Tenn., for the contractors' section, and Francis P. Smith of New York, well known consulting engineer, for the research section. Members of the committees include J. N. Mackall. state highway commissioner of Maryland; Geo. H. Henderson, state highway engineer of Rhode Island; Jay Downer, chief engineer of the Westchester County, N. Y., Park Commission; John B. Hittell, chief paving engineer of Chicago; W. W. Horner, chief engineer of sewers and streets, St. Louis; C. A. Mullen, secretary of the Association of Asphalt Paving Technologists, Montreal, Canada; W. J. Emmons, research specialist of the U. S. Bureau of Public Roads; A. K. Vickery, city engineer, Denver, Colo.; George F. Fisk, first assistant city engineer, Buffalo, N. Y.; F. T. Bullen, Caddo Parish engineer, New Orleans, La.; Roy M. Green, manager Western Laboratories, Lincoln, Neb.; Henry L. Howe, testing engineer, Municipal Laboratory, Rochester, N. Y.; Leroy M. Law, chief chemist, New Orleans Refining Co., New Orleans, La., and others equally prominent.

Southern states have made notable contributions to highway engineering science in the utilization of local materials, including the sand asphalt roads in Eastern North Carolina, the lime-rock base asphalt roads in Florida, the limestone and gravel base asphalt roads in Georgia, the penetration macadam roads in Tennessee, and the extensive black base paving construction in South Carolina and Georgia, while Alabama is in the forefront with a recent twenty-five million dollar bond issue for state highways.

The most economical and effective methods of surfacing gravel and macadam roads, of which most of the states have a considerable mileage, will be given emphasis in the discussions. Stage construction of highways, involving completion in a period of years, will also be compared to the method of making larger immediate outlays for complete construction. Model county construction and management will be presented by representatives of the counties in the different sections of the country which have been successful to an outstanding degree in acquiring and maintaining efficient highway systems at low cost. This, it appears, will attract widespread attention. Among the most successful counties in this respect are Burlington County, N. J.; Harrison County, Miss.; Caddo Parish, La., and Muscogee County, Ga. Efforts will be made at the conference sessions to simplify specifications, tests and designs, and eliminate a considerable portion of the confusion now prevailing in the requirements of states, counties and cities. Of particular interest to farming communities and railroads will be the subject of radial highway development versus through trunk lines as affecting the needs of farming communities and the shipment of local products from rail points.

Atlanta, frequently referred to as the convention city of the South, is entered by eight railroads and is equipped with more than seventeen hotels. Points of interest to visitors include "The Wren's Nest," home of Joel Chandler Harris, famous battle fields of the Civil War, and the partly completed impressive Confederate memorial at Stone Mountain. Reduced rates on all railroads in the United States and Canada have been granted for the conference.

Pacific Portland Moving to New Offices

It is reported from San Francisco that the eleventh floor of the new twenty-two-story Hunter Dulin building has been leased to the Pacific Portland Cement Company. The entire floor, according to the announcement, is now being fitted for the occupancy of the company, which recently merged with the Old Mission Portland Cement Company.

Yosemite Portland Elects Two New Directors

According to a report from Fresno, California, Howard G. Tallerday of San Francisco, vice-president and manager of the Western Pipe and Steel Company of California, and Frederick Thompson, vice-president of the Pacific Electric Manufacturing Company, have been elected to the board of directors of the Yosemite Portland Cement Corporation.

Tallerday was one of the original organizers of the Western Pipe and Steel Company, and has held executive positions with other California corporations, including two shipbuilding concerns. Thompson was for a number of years sales manager of one of the largest Pacific Coast cement corporations, and was later with other Coast companies. Still later he was vice-president of the Hellman Bank, Los Angeles.

Florida Cement Plant Begins Operations in September

According to a report from Tampa, first orders for cement manufactured in Florida will be filled at the new $5,000,000 plant of the Florida Portland Cement Company at Hooker's Point before the first of October. The plant has been under construction for the past year and a half by the Cowham Engineering Company of Chicago, under the supervision of Frank E. Dodge, chief engineer, and J. A. Curtis, general superintendent. It is now so near completion that shipments of raw material from the company's quarries and clay pits have already begun. These are located near Brookville, where the company has expended $200,000 in development. A railroad four and one-fifth miles long has been built to the quarry. Two carloads of dynamite have already been used in blasting a cut three-quarters of a mile long into the big limestone hill, exposing a rock face 30 feet high from which a steam shovel will load cars.

Pioneer Sand and Gravel Erects Office Building

A two-story mill construction office building, according to a report from Seattle, Washington, will be constructed, at a cost of $35,000, for the Pioneer Sand and Gravel Company at 901-911 East Harrison street, at the corner of Ninth Avenue North. The building will occupy an area of 120 by 60 feet. The work is to be carried out under the supervision of officials of the company.

Washington Silica Company Pushing New Plant

According to a report from Auburn, Washington, W. W. Evans, superintendent of the Washington Silica Company, is completing the installation of boilers, pump, rotary drier with a capacity of 20 tons daily, screens and washing apparatus at the company's pit in Green River Valley. A big oil tank, already installed, will supply fuel, in the form of crude oil, for the boilers and driers.

The company's product will be used in stucco work and is of excellent quality for both interior and exterior work. There is also a valuable deposit of glass sand and molding sand for cast steel. This is so hard that a dull pick used in digging it out soon becomes almost as sharp as a razor.

A good grade of talc is also found in the deposit and the company will install settling basins to recover this material as the sand is washed.

Superior Sand and Gravel in Hands of J. W. Hoover

J. Webster Hoover, former highway commissioner of the state of Washington, assumed charge, on July 18, of the Superior Sand and Gravel Company, with headquarters at Seattle. The company operates pits at Friday Harbor and other Puget Sound points and also has a ready-mixed plant at Seattle. In the reorganization of the company, Norman Hill, who was employed by the state highway department several years ago, will have charge of local distribution.

J. W. Karch Buys Deposit

John W. Karch, of Celina, Ohio, it is reported, has purchased from J. W. Cummings, of Motpelier, Indiana, an 80-acre farm east of that city and will install a large crushed stone plant. Mr. Karch now operates a quarry at Celina and also one in Jay County, Indiana. His recent purchase lies along the Salamonie River and is underlaid with limestone.

Chemical Industries Exhibit

The Eleventh Exhibition of Chemical Industries, which will be held September 26 to October 1 at the Grand Central Palace, New York, promises to be of unusual interest. From 350 to 400 exhibits are already assured, many of which will be shown for the first time, this number greatly exceeding anything of the past. The various chemical societies which will meet here at the time of the exhibit are cooperating to make this the biggest and best exhibit in history.

"Lone Star" Launched

A large sea-going, Diesel-driven tug was launched on June 21st at the Marvel shipyard, Newburgh, New York, for the International Cement Corporation. The tug was christened "Lone Star" and is now proceeding south for towing service between the raw material deposits at St. Stephens, Alabama, and the new mill of the Louisiana Portland Cement Company at New Orleans.

The tug's Diesel engine is of 500 brake horse-power, which makes the craft an exceptionally powerful towboat. The "Lone Star" is of about 200 tons displacement and has trimming tanks at either end with pipe line connection so that water may be discharged from aft to forward tanks, or vice versa, to alter the trim of the boat according to the necessity for change of draft at either end. The tug has a fuel oil capacity of 25 tons, which is sufficient for about nine days' operation, or about 1900 miles, without replenishing.

The tug will haul barges of limestone from the raw material deposits at St. Stephens to the new mill at New Orleans. For this service a fleet of steel barges have been constructed for the International Cement Corporation by the Nashville Bridge Company, Memphis, Tenn. These barges will be known as the "Lone Star Fleet." The tug will tow three barges on each trip and will make six round trips a month.

Six of the barges have a capacity of 1200 tons each and three others, completing the fleet, are of 600 tons capacity each. These barges were built according to designs prepared by International's engineering department, and are electrically welded instead of riveted, this being the most advanced method of construction. The barges are of the deck-loading type. The 1200-ton barges are each 180 feet long, 40 feet wide and 9½ feet deep.

New Cement Kiln Installed at Mariel, Cuba

The Cuban Portland Cement Corporation, subsidiary of the International Cement Corporation, has installed a new kiln and other additions to its plant at Mariel, Cuba, in order to serve better the growing needs of private and government users in the island.

The additions to the plant include not only the construction of this fifth kiln, but also the erection of a new concrete stack, the installation of grinding and handling equipment and the increase of transportation facilities.

When these additions are completed the total capacity of the plant will be increased to 2,000,000 barrels a year, which appears to be ample to take care of the total cement requirements of Cuba for several years to come.

Mariel is located 25 miles west of Havana, in which latter city the company has a new warehouse which is one of the finest in the world. Cement is shipped in bulk by barge from Mariel to Havana, where it is unloaded at the new warehouse for storage to be shipped as required by water, truck or rail.

Nevada Rock and Lime Plant Damaged by Fire

The plant of the Nevada Rock and Lime Company's plant at Sloan, Nevada, narrowly escaped destruction recently, according to a report from Las Vegas, when a fire of unknown origin razed the power house and reduced the machinery within to a tangled mass of wreckage. A favorable wind blowing directly away from the rest of the plant saved the mill and other buildings. J. L. Fertig, superintendent, estimated the damage at $80,000, fully covered by insurance. The power house furnished the power to operate two big kilns, and in addition included the rock crushing unit.

Part of the plant destroyed was the 150 horsepower unit added last year and which had been in operation not quite twelve months. The other power unit, a 60 horsepower plant, was completely destroyed, as were all the line shafts, rock crushers, etc. The bases of the two big stacks are believed to be badly damaged, but the two kilns are thought unharmed.

Work of clearing away the debris has been started, and Mr. Fertig says between six weeks and two months will be necessary to completely rebuild the unit. No men were thrown out of work, the superintendent says, as the rock production is being continued and all the laborers have been transferred to that work.

The plant was just getting under way on a production basis of 10 tons of lime per day to take care of an unprecedented rush of business. J. C. McGinnis, assistant general manager, and several other officials of the company were on the ground at the time of the fire, and immediately authorized preparations to rebuild.

Jones Scott Improves Plant

The Jones-Scott Sand and Gravel Company of Umatilla, Oregon, is constructing a washing plant in connection with its sand and gravel bunkers. The work is now under way.

NEWS OF EQUIPMENT MANUFACTURERS

Largest Spherical Bearings Used in Cement Plant

Two huge S K F spherical bearings, of the type shown in the illustration, the largest of their kind, have been successfully operating for a period of over three years in a "cylpeb" cement mill at the plant of the Dexter Portland Cement Company, Nazareth, Pennsylvania. These bearings, almost three feet in diameter, are carrying the load of a 5½ by 26 foot tube mill used in pulverizing. The mill is driven by a 250 h.p. motor at a speed of 26 r.p.m. The load is 50 tons, or 25 tons per bearing.

During the three-year period, these bearings have been on the job continuously and the only attention required has been the replenishing of lubricant several times a year. In addition to carrying heavy thrust and radial loads, an important feature of these bearings has been their self-aligning characteristics. Any inaccuracies in setting up and settling of foundation are compensated for within the bearings without the need of any external aligning devices or the setting up of internal strains or stresses.

These spherical bearings differ in principle from the conventional type of roller bearing in that they are self-contained and non-adjustable units. They are made of high carbon chrome steel and uniformly hardened throughout. The rollers are of a barrel shape, and each of the two rows of rollers is permitted to operate independently of the other. The rollers and races are made from charcoal steel, a product of the S K F iron ore mines and steel mills in Sweden. Each roller is drop-forged and individually turned between centers to high precision.

In frictional characteristics, the spherical bearings run a close second to ball bearings. They are made as well as S K F ball bearings, from the standpoint of materials, workmanship and finish.

For nearly ten years, S K F spherical bearings have been furnished on big jobs in industry where the service demands rugged and unfailing performance under exacting conditions of load and speed. These applications include loads of over 50,000 pounds per bearing. They are built in the largest sizes and today are being used on giant steel mill motors, rolling mills, rock crushers, coal crushers, etc.

Large Spherical Bearings

Special Steel Described

"Farrell's 85" is the title of a new booklet which describes and illustrates the product of the Farrell-Cheek Steel Foundry Company. The steel is manufactured in five grades, known as A, B, C, H, and HH, the first three of which are claimed to have unusual abrasion-resisting qualities while the other two grades are general purpose steels. The grades A, B, and C have tensile strengths of 100,000 lbs., 150,000 lbs., and 175,000 lbs. respectively with yield points of 60,000 lbs., 113,00 lbs. and 140,000 lbs., and Brinnell hardness test numbers of 250, 300 and 400. These physical properties would indicate that these grades of "Farrell's 85" steel are especially suitable for such castings as bucket lips, digger teeth, conveyor chain, ball mill screens, etc., and the booklet illustrates many uses of this sort.

As the grades A, B and C are difficult to machine after completion of the hardening process the company has its own machine shop in which it offers to do any necessary machining for its customers before the hardening process has been completed.

All of these services and many more interesting details concerning their special process steel are described in catechism form in this new booklet of the Farrell-Cheek Foundry Company.

C. G. Olson Transferred

Mr. Charles G. Olson, formerly of the main office of the Chain Belt Company, has been transferred to the Detroit office. Mr. Olson was connected with the sales department for several years before his transfer. He will look after the Rex Chain and Engineering business of the company in Detroit territory with headquarters at the company's office at 8855 Woodward avenue.

Riddell Company Purchases Hadfield-Penfield

W. A. Riddell Company announce the purchase of the Hadfield-Penfield Steel Company, the American Clay Machinery Company and the Era Steel Company, and that they will continue and develop the business of these concerns.

New Hayward Bucket

Extensive development work by The Hayward Company has resulted in a new design of Hayward drag line bucket. In developing the new bucket, Hayward engineers incorporated in its design a number of desirable new features. Like all other buckets in the Hayward line, it is made in a variety of sizes from ¼ cubic yard up.

This bucket is designed to stand up under the hardest kind of usage. It is a rugged, strongly reinforced bucket of great strength, which will withstand the severe strains to which a drag line bucket is subjected in its various applications to surface and sub-soil excavation. While this bucket includes many new features of design, it is not an experiment, it has been thoroughly tested under actual operating conditions and it was used on the hardest of digging. These operations in the hands of contractors have demonstrated very forcibly the practical nature and value of its design and show that it is capable of enduring the severest kind of service in digging.

Its great digging power is exemplified by a typical digging job recently accomplished on Long Island. A ¾ yard bucket operated by a caterpillar tread crane was digging and handling wet, sticky clay which was overgrown with meadow grass. Its average load was one that crowded up to the spreader-bar. When this bucket was pulled a distance one and one-half times its own length into material previously noted, it dug so deeply that a full load had gone over the back of the bucket, and the bucket still retained a full load when it was broken away from the material. In digging, the bucket was thrown out beyond the end of the boom, landing on its teeth. When strain was put on the pulling line, the bucket quickly assumed its digging position and was filled in its own length.

This bucket will dig any material that does not have to be blasted. It can be handled by any type of operating machine, with varying lengths of boom. It carries a full load to the end of the boom with practically no spilling. It is quick in operation because of constructional advantages.

Some of the advantages which contribute to the efficiency of the bucket are as follows. It starts to dig as soon as the drag line is pulled tight, whether the material is loose muck or "rotten rock," or any other material that a drag line bucket can handle. The angle of the bucket in its carrying position is such that there is practically no loss of material from the time the bucket is filled until it dumps. Furthermore, the carrying position of the bucket is maintained throughout the swing to the spoil-bank. Dumping is greatly facilitated because of the short bridles and the fact that there are no obstructions to the passage of the material from the bucket.

A feature retained in this bucket, which is a distinctive feature of all Hayward drag line buckets, is the open front construction. To prevent the open front from pulling together with the pulling strain, heavy top reinforcing plates are used, with cast steel pulling lugs running from the back of the bowl to the front, at which point the pulling bridles are attached to the pulling lugs. The cutting edge of the bucket is made of manganese steel and runs from the top of the bowl on one side, extending across the bottom, to the top of the bowl on the opposite side. This cutting edge helps to reinforce the front part of the bowl. The bowl itself is made of reinforced heavy steel plates and has stiffener runners to prevent wear on the bottom of the bowl plate. The digging bridles are made of hand forged steel dredge chain, as are the short carrying bridles. The adjusting bridles are made of heavy steel wire cables.

This new bucket, like the model which it supersedes, has no rigid bales or bridles. Adjustments between the hauling chain and the cables enable the operator to enter the bucket into the material at any desired angle. A feature that will appeal to contractors having operating machines with short booms is the low head-room which this bucket requires for its operation, which also permits the making of higher spoil banks with fewer moves of the operating crane or hoist.

The sheaves on which the dumping cables are carried are made of cast steel, bronze-bushed, and fitted with a specially designed swivel adjustment. Like all other types of Hayward buckets, this type is built on the interchangeable parts system. This means that when duplicate parts are required, they are promptly shipped from stock, and can be immediately placed in service without further fitting. Another feature in the construction of this bucket is the fact that it has a "four point pull" hauling bridle which keeps the bucket in a predetermined position throughout its digging path. It should also be noted that the arched spreader-bar allows a maximum amount of overload to be dug and carried.

New Hayward Bucket

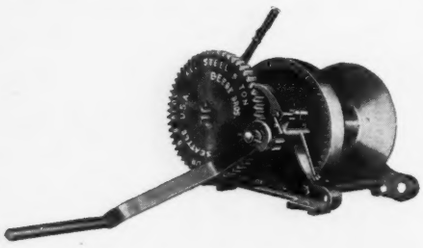
Sprout, Waldron Take Over Valley Iron Works

Sprout, Waldron and Company have taken over all the patterns, equipment, etc., of the Valley Iron Works of Williamsport, Pa., and will now handle all Monarch transmission appliances, including a complete line of milling machinery equipped with Westinghouse motors and controllers.

To take care of this transmission business a separate and distinct department has been organized. A new machine shop and stock room with 5,000 square feet of floor space has been built and equipped. The foundry has been enlarged to double the former capacity and special machinery for manufacturing this class of equipment has been installed. Large stocks of all sizes, standard bearings, couplings, collars, take-ups, etc., will be maintained for immediate shipment.

An All Steel Utility Hoist

Illustrated below is the "B. B. Bros." all steel hand hoist which finds a variety of uses in the pit and quarry field. In the construction of mills, the placing of machinery, hauling timbers for aerial cableways and as either a stationary or portable general utility hoist this little machine, which weighs only 110 pounds, is claimed to be "the strongest geared power for its weight in the world."



It is made with two quickly shifted main speeds and instantly adjustable handle to give a wide range of speed and power to conform with various loads. The crank pinion and shaft fit into a counter-sunk recess in the center of the external gear when a gear-ratio of 4-1 for rapid lift of loads up to 1,500 pounds is desired. When this crank pinion shaft is placed into the lower steel bearing, as shown in the illustration, a compound gear ratio of 24-1 is obtained for loads up to 5 tons. When bolted on a small, substantial frame with anchor line attached to tail hold yoke so that the hoist and not the frame is taking the pull, this combination makes a most practical, portable hand-power unit.

The hoist is equipped with a positive cam action internal steel brake, lined with high grade wire inserted brake lining, engaging the internal rim of the outside gear, giving a 4-1 braking ratio on the drum, and is operated with a steel cam lever easily controlled to any desired brake pressure.

Climax Dealer Moves Offices

The J. L. Latture Equipment Company, of Portland, Oregon, representatives in Oregon, Washington, and Idaho, of the Climax Engineering Company, are now located at 312 to 314 E. Madison Street, Portland, Oregon. The new location is in a four-story fire-proof building and will house both offices and warehouse of the Latture organization. A line of Climax engines, power units, and replacement parts are carried in stock and Climax users in the northwest can obtain parts from this dealer upon application.

Power Transmission Data Included in New Catalog

An interesting new catalogue of power transmission and engineering information has just been issued by The Hill Clutch Machine and Foundry Company. This catalogue number twenty-six is divided into three sections—A, B and C.

Section A illustrates and describes a new flexible coupling of unique simplicity, flanged and compression coupling, shafting and bearings. A large part of this section is devoted to the illustration and description of the remarkably efficient "Cleveland Type" oil film bearing, in which the rotating shaft or journal is supported without metallic contact, on a nearly frictionless film of oil. Complete data are given on a heavy duty form of this bearing, in which bearing temperatures, due either to external heat or high speed and heavy pressures, are controlled by cooling the lubricating oil with a circulating water cooling system. Another item in this section is an improved type of clamp for securing bearings to structural steel without the necessity of drilling holes.

Section B covers fully the application of the patented "Smith Type" Hill clutch pulleys and cut-off couplings including quill drives. A complete horsepower table is presented from which friction clutch or plain pulleys may be chosen to meet any requirements. Full data and dimension tables enable the designer to incorporate any of the standard forms of "Smith Type" Hill clutches in power transmission layouts. Following pages take up transmission of power by belting, giving formulas and tables covering the horse-power of leather belting. Application of belt tighteners to secure maximum horsepower transmitted is discussed in detail. The application of the new "Steel-arm" automatic belt tightener, which provides means of scientifically controlling belt slip, will be of interest to engineers and power transmission men in many industries.

Section C illustrates and describes both American and English systems of rope drives; agitator designs, parts and gearing; "Forged-Cast," iron cast tooth, and cut spur and bevel gears; "Industrial Type" speed transformers; and a wealth of pertinent engineering data, such as bolt strengths and dimensions, pipe dimensions, threads and tap drills, sheet and wire gauges, fusion temperatures, tables of allowable loads on structural shapes, concrete data, trigonometric functions, areas and circumferences of circles, etc.

The various industries using agitators will find the standardized agitator parts very helpful in laying out and building up agitator units at small expense. For agitator and other slow speed machine drives, the "Industrial Type" speed transformer provides an ideal means of obtaining the required low speed direct from a high speed motor. This speed transformer consists of an oil tight cast iron housing enclosing a train of spur gears. All gears have 20 degree involute generated teeth. Pinions are hardened. Mating gears are "Forged-Cast." Automatic flood lubrication of the nicely fitted bronze bearings eliminates friction and maintenance. Every gear or pinion is supported between two bearings.

The "Forged-Cast" gears used in the "Industrial Type" speed transformers represent the latest development in gear manufacture. The teeth of these gears are generated in a solid forged and machined steel ring, into which has been previously cast, by a special process, an iron hub and web or arms. The union of iron hub and steel rim is a laminated weld, and the finished gear is one integral piece. Since the teeth are cut in solid forged steel, 100 per cent tooth strength is assured. These gears are available for general mill and machine reduction gearing. The portion of Section C covering gearing illustrates actual tooth sizes for usual pitches, and gives gear horsepower in tabulated form, calculated from Lewis formulae.

The three sections of catalogue number 26 have a total of 258 pages, and are substantially bound. Each section is profusely illustrated and line drawings of individual products furnish controlling dimensions of all sizes. Engineers, master mechanics, plant superintendents and purchasing agents will find this new catalogue a power transmission text book in three convenient volumes.

Climax Moves Chicago Branch

The Chicago office of the Climax Engineering Company has been removed to 1608 Harris Trust Building, 111 West Monroe Street. This office was previously located in the same building, but on a different floor. Mr. F. E. Blanchard is in charge of the Chicago branch of the Climax Engineering Company.

The Dorr Company announces that Mr. A. Anable, for several years connected with its equipment sales department, was appointed on August 1st to the position of director of publicity.

Beaumont Describes Cableway

In a new brochure illustrating and describing their one-man operated slackline cableway excavator, the R. H. Beaumont Company describes a method of handling the threefold job of excavating, elevating and conveying with the minimum amount of labor.

Wherever excavating is to be done over a large area and whenever the material must be lifted and conveyed from 250 to 1,000 feet this excavator will give a low cost, high speed operation. Hard, close-packed materials, as well as material in deep pits or under water, are readily handled with the special design of bucket used. Through a unique hook-up of the loading and dumping chains the bucket takes a tilted position as it bites into the material, greatly facilitating the digging operation where the "going" is difficult. Two types of buckets are available, one for light digging and one for heavy digging.

The hoists for this system of slackline cableway excavator are built for steam, electric, gasoline and belt power. Bed plates are of cast gray iron, I-beam section, proportioned to give maximum stiffness and strength, and the housings are of cast iron T-section, strongly webbed, accurately machined on bottom and joined to bed plate by turned bolts in reamed holes. Bearings are liberal in dimensions and their housings and caps are planed and slotted accurately, fitted, lined with high grade babbitt metal. Drums are a special mixture of cast iron, accurately machined on face and balanced, properly ribbed to withstand all crushing strains. They are bronze bushed. Shafts, drum, crank and countershafts are of forged steel, turned and ground. The brakes are of the heavy differential band type, lined with non-burn woven asbestos material, and brake bands are suspended from brackets by coil springs, insuring complete release when not in use. Operating levers are mounted in a battery in notched quadrants on heavy cast iron stand and frictions are operated by hand levers. Brakes are operated by either hand or foot levers and all levers are forgings and fitted with brass thumb latches. All parts requiring grease are equipped with Alemite fittings. The front drum is equipped with two band friction clutches for high and low speeds. Speed change can be instantaneously effected with motor or engine running.

One man, the hoist operator, controls the entire system, digging and dumping the bucket when and where he desires.

New Brick Unloader

A new brick unloader in the form of a 40 foot conveyor with special features designed to speed up this class of work has ben brought out by the George Haiss Mfg. Company, Inc. The machine consists of a conveyor frame, 40 feet long, mounted on swivel wheels that are placed on a dock. The lower section, or opposite end, is mounted on a two wheel truck which has a fifth wheel swinging arrangement and a pole extension that allows the laborers to move it and steer it in the desired direction for moving on and off the boat.

These wheels are connected to the axle by means of auto truck type knuckle axles and from the axle are supported to the conveyor by 2½ inch extra heavy pipe. This pipe is so arranged that one end is stationary and the other pivoted, and by means of a winch the conveyor can be raised or lowered.

One of the attractive features of the machine is the fact that it is equipped with wire belt 20 inches wide, running on ball bearings, the rollers being mounted on a spring-suspended box which allows them to release and not take the direct jar of the brick thrown on the belt by the laborers. The head and tail pulleys are large in diameter, logged with oak, and the whole is driven through a Diamond 1½ inch pitch roller chain by an electric motor or gasoline engine.

Tile for Furnace Walls

Reintjes flexible corner bonding tile is the name of a product which is claimed to effect a material economy in the maintenance and a substantial lengthening of the life of furnace walls. This tile eliminates the common faults of corner construction and effects perfect bonding in both side and wall.

It provides ample clearance for expansion at the corners and ties together the side and end walls, preventing the front wall falling inward.

The bonding tile can be placed in the side wall at intervals to take care of expansion needs, the expansion joint being provided either by parting of the tile, or clipping with trowel the end of one tile.

It is the thickness of one course of brick and serves as a starting brick for each course. The joints break at each succeeding course and form a perfect corner of the inner nine inch refractory lining. The tile in each course overlaps the next lower course, further strengthening the structure. The tile is developed for use when the brick are set in the solid header or quarter bond patterns. Two corner bonding tiles displace three brick and one soap.

New Tension Sleeve Coupling

Because many kinds of modern equipment require a quick disconnecting flexible coupling on the driving shaft to facilitate quick changes in hook-up, or to allow for using one motor to drive different machines at different times, the Ajax Flexible Coupling Company have developed and are marketing a tension sleeve coupling.

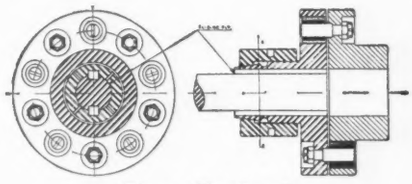


Figure Number 1

This flexible coupling, a modification of the standard Ajax rubber bumper coupling, is made so that the flange attached to the driven shaft is readily removable. The removable half (see Figure No. 1) is made with an extended split hub on the driving flange, the hub being tapered on the outside, and threaded over one-half its length, nearest the flange. A collar, made to fit over the threaded hub, screws up to a tension fit, tightening the hub to the shaft, being further held in place by set screws, fitted over two sliding keys.

This type of coupling can be connected or disconnected in a very few minutes, the only tools required being a pipe and set screw wrench. The removable flange and collar are made of steel, all other parts being identical with standard Ajax couplings, and so interchangeable in case of accidental breakage.

New Speed Controller

A new page for the General Electric catalog describes and illustrates a remote-indicating speed controller for a.c. slip-ring induction motors. The combination consists of an automatic starter and control station, providing simplicity of control for a.c. ventilating systems. From the control station it is possible to start and stop the motor and run it at any one of four speeds for fan or blower.

Smooth and automatic acceleration is obtained by definite time relays. It is possible when running at any speed to change to any other speed simply by pressing the button indicating the speed desired. Upon reaching the speed selected a light shows on the control station, a red light indicating full speed; green, third speed; blue, second speed; and white, slow speed.

Rates for display advertisements in the Broadcast Section are given below. If you want to buy or sell used equipment, if you want a job or need a man, advertise your wants in Pit and Quarry. Advertisement copy for publication in the next issue should reach our office within one week after the date of this issue.

RATES PER INSERTION	1 Inch	2 Inches	3 Inches	4 Inches	5 Inches	6 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches	20 Inches	30 Inches
1 Insertion	$3.75	$7.25	$10.75	$14.25	$17.75	$21.25	$28.25	$31.75	$35.25	$42.25	$56.25	$70.25	$105.00
2 Insertions	3.75	7.25	10.70	14.20	17.65	21.15	28.15	31.65	35.15	42.15	56.15	70.00	104.00
3 Insertions	3.75	7.20	10.65	14.15	17.55	21.05	28.05	31.55	35.10	42.05	56.05	69.75	103.00
4 Insertions	3.70	7.15	10.60	14.10	17.45	20.95	27.95	31.45	35.00	41.95	55.90	68.75	101.00
8 Insertions	3.65	7.05	10.50	14.00	17.25	20.75	27.75	31.25	34.80	41.75	55.70	67.50	98.00
13 Insertions	3.60	6.95	10.40	13.90	17.05	20.55	27.55	31.05	34.60	41.55	55.55	66.25	94.00
26 Insertions	3.50	6.75	10.20	13.70	16.65	20.05	27.05	30.65	34.20	41.05	55.05	64.00	88.00

INFORMATION—*"Broadcast"* space is sold by the advertising "inch." Each page contains 30 inches. The width of the page is divided into 3 columns, each 2¼ inches wide. Each column contains 10 inches measured the length of the column. Any space may be used measured by the *even* inch in height (not fractions), by 1, 2 or 3 columns in width. The size of a space is its height in inches multiplied by the number of columns in width. Example: a space 3 inches high by 2 columns wide is 6 inches. Copy changes made without additional charge.

Complete Service Publishing Company

538 South Clark Street **CHICAGO**

Here's a Guarantee that means Something:

"30 Days Trial IN SERVICE"

All equipment overhauled in our Shop is furnished in guaranteed condition, subject to thirty days' trial in service

GUARANTEED EQUIPMENT—FOR SALE OR RENT

STEAM SHOVELS—RAILROAD

1—Model 80 Marion, Shop No. 1312, 4 yd.
3—70-ton Bucyrus. Shop Nos. 920, 939, and 1233. 2½-yd. dippers.
1—Model 60 Marion. Shop No. 2059, 2½-yd. dipper.
3—60-C Bucyrus. Shop No. 1286, 1358 and 1640, 2½-yd. dippers.
1—45-C Bucyrus. Shop No. 1202. 1¾-yd. dipper.

SHOVELS Full Revolving

1—37 Marion. Shop No. 4773, 32 ft. boom, 22 ft. dipper arm, 1¼-yd. dipper. Caterpillars.
1—Osgood 29, Shop No. 1170, standard boom, 1-yd. dipper, steel caterpillars.
1—20 B Bucyrus, Shop No. 4103, stand, boom equipment, steel caterpillars, A.S.M.E. boiler.
1—30-B Bucyrus, Shop No. 3922. Standard boom, 1-yd. dipper, steel caterpillars.
3—Type "B" Eries Shop No. 1219, 1989, and 2152, high lift, ¾ yard. Steel caterpillars.
1—Model 21 Marion, Shop No. 4294, steel caterpillars, ¾ yd.
1—Type O Thew, Shop No. 1777, high-lift, traction wheels, 2-3 yd. dipper.
1—18-B Bucyrus. Shop No. 1870, ⅞-yd. dipper. Traction.

SIDE DUMP CARS

9—30-yd. Western all steel air dump.
45—20-yd. Western, all-steel, air dump.
12—18-yd. Western, all-steel.
67—16-yd. Western, wood beds, air dump.
59—12-yd. Western Side Dump, wood beds.
2—6-yd. Western, wood draw sills, wood beds.
4—6-yd. K. & J. Steel Sills Truss-rod doors.
23—5-yd. K. & J. 36-in. ga. steel draw-sills, wood beds.
12—4-yd. Western 36-in. gauge, steel sills.
4—5-yd. Western, 36-in. gauge, heavy Duty.
5—2-yd. Western, 36-in. ga., wood draw-sills, wood beds.

STEAM SHOVEL PARTS

All repair parts on hand for Model 60 Marion and standard 70-ton Bucyrus Steam Shovels.
1—Std. boom, dipper arm and ¾-yd. dipper for Type "B" Erie.
1—40-ft. steel boom, drum, etc. for Type "B" Erie Crane.

LOCOMOTIVES

1—16x24 Vulcan four-wheeled Switcher, Shop No. 1764, Wt. 40 tons.
1—13x18 American 4-wheeled saddle tank, Shop No. 47106, weight 30 tons, steam brakes.
1—11x16 Standard Gauge American four-wheeled Saddle Tank, Shop No. 46519, weight 21 tons.
1—11x16 Porter four wheeled Saddle Tank. Shop No. 6717 A.S.M.E. boiler. Wt., 21 tons.
2—10x16 Porter 4-wheeled Saddle Tanks, 36-in. ga., Shop Nos. 3399 and 3509, Wt. 19 tons.
1—9x14 Porter 36-in. gauge saddle tank. Shop No. 6960.
2—30-ton Climax Locomotives, 36-in. ga. New 1925.
4—7-12 Davenport and Vulcan, 24-in. gauge, 9-ton dinkies.
1—9-ton Whitcomb Gasoline, 36-in. ga. Shop No. 11593.
2—7x12 Davenport, 36-in. saddle tank. Shop Nos. 1566 and 1567.

SPECIALS

1—Model 105 Northwest Shovel, Shop No. 1064, standard boom, 1-yd. dipper, steel caterpillars.
2—Model 105 Northwest Combination Dragline and Crane, Shop No. 710, and 862, 40-ft. boom, bucket-operating drums, fairlead, steel caterpillars.
2—No. 1 Koehring Combination Drag-standard boom, ¾ yard dipper, steel caterpillars.
2—No .1 Koehring Combination Draglines and Cranes, Shop Nos. 383 and 384, 40-foot boom, fairlead. Steel caterpillars.
1—Model 206 P. & H. Gasoline Crane, Shop No. 2129, 38-foot boom, bucket-operating drums, steel caterpillars.
1—Model 210 P. & H. Gasoline Dragline, Shop No. 1077, 40 or 50-ft. Boom, 1-yd. Dragline bucket. Armored caterpillars.

DRAGLINE EXCAVATORS

2—Class 14 Bucyrus, steam operated. Shop Nos. 2140 and 3706, steel caterpillars, 60-ft. boom, 2-yd. bucket. A.S.M.E. boiler.
2—No. 2 Monighan steam operated. Shop No. 789, skids and rollers. 60-ft. boom, 2 yd. Page bucket.
1—30-B Bucyrus Shop No. 3922, steel caterpillars, 40-ft. boom, 1-yd. Page bucket.
1—Model 210 P&H Gasoline Dragline. Shop No. 1077 Armored caterpillars. 40-ft. boom, 1-yd. Page bucket.
1—30-B Bucyrus, Shop No. 3922, steel caterpillars, 40-ft. boom, 1-yd. Page bucket.

SPREADER CARS

1—36-in. gauge Western Wood Spreader.

CRANES

1—30-ton, std. Cg., Industrial Crane, Shop No. 3261, 55-ft. boom, 20-ft. extension.
1—Dock Crane, bucket operating, 50-ft. boom, 7 ft. 10 in. gauge, 12-in. wheel-base, capacity 15 tons at 18 ft. radius.
1—15-ton Brownhoist 8-wheeled Crane. Shop No. 4520.
1—20-ton McMyler, No. 388, 50-ft. boom. bucket operating.
1—18-ton Brownhoist, Shop. No. 6583, 50-ft. boom, bucket-operating, A.S.M.E. Boiler.

BUCKETS

1—½-yd. Blaw-Knox "Dreadnaught" Clamshell.
1—¾-yd. Williams "Favorite" clamshell.
1—1-yd. Owen Clamshell.
1—1-yd. Browning, Digging Type with teeth.
1—1¼-yd. O. & S. Clam Shell.
1—1½-yd. Brownhoist Clam Shell.
1—1½-yd. Mead-Morrison Clam Shell.
2—2-yd. Class C Page Dragline.

MISCELLANEOUS

2—5-ton Holt Tractors, factory rebuilt.
2—5-ton Bates Tractors, practically new.
3—50 ft. Camp Cars.
1—No. 7-S Knickerbocker Concrete Mixer with power loader and water tank on trucks. New.
35—Milburn Carbide Lights.
1—No. 55 Buhl Portable Air Compressor.
1—Model 10 Keystone Mixer, low charger. 6 Hp. Novo Gas Engine.
1—No. 6 Keystone Mixer, 3 Hp. Novo Engine.
1—7x8 Gould triplex Pump, belt driven.
1—4x6 Fairbanks-Morse Duplex Pump with 7½ hp. motor.
5—Thomas Single Drum Electric Hoists with Motors and Starters.

CLAPP, RILEY & HALL EQUIPMENT CO.

WORKS: CLYDE, ILL. 14 NORTH CLINTON ST., CHICAGO, ILL.

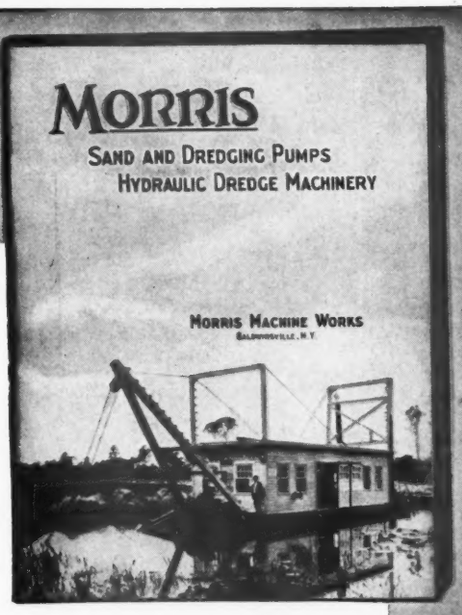
BECK, RILEY & HALL EQUIPMENT CO.

458 UNION TRUST BLDG., PITTSBURGH, Pa. WORKS: NEVILLE ISLAND, PA.

For BIG PRODUCTION at STEADY RATE and with LOW LABOR COST

A MORRIS Sand Pump, operated by electric motor, or steam, gasoline or Diesel engine, keeps on delivering at a dependable date as long as row material is available at the suction. If the material there is semi-solid or contains clay or boulders, a suitable nozzle, cutter head or suction screen can be utilized at the inlet to get the desirable deposit and reject what is useless or might otherwise hinder steady flow through the pump or line. An outfit similar to that shown can often be operated by only one man on the dredge, one at the screening plant and a third to help out at both places.

If you want suggestions, cost and performance data from our Engineers, give us details when writing for the bulletin.



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Baldwinsville, N. Y.

Originators of Centrifugal Pumps, both Single and Multi-Stage, and builders for practically all purposes since 1864.

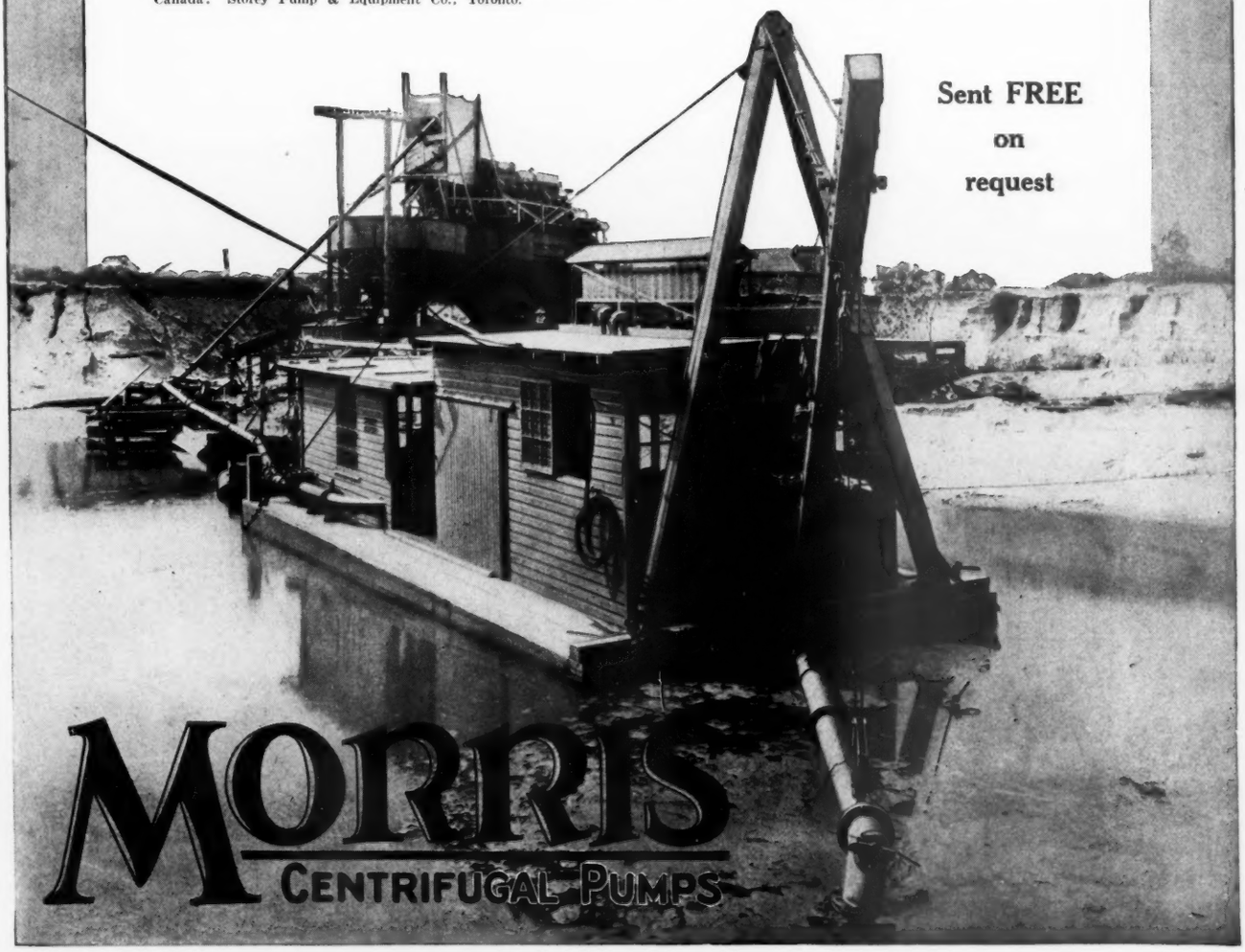
Branch Offices—New York, 26 Cortlandt Street; Philadelphia, Witherspoon Building; Cleveland, 1367 E. Sixth St.; Chicago, 217 N. Jefferson Street; Boston, 79 Milk Street; Pittsburgh, 320 Second Avenue; Detroit, Penobscot Building; Houston, 110 Main St.

Sales Representatives—Buffalo, Kansas City, Omaha, Denver, Salt Lake City, Portland, Ore.; Los Angeles, New Orleans, Huntington, W. Va.
Canada: Storey Pump & Equipment Co., Toronto.

Write for Bulletin 125

56 pages with over 125 illustrations showing where, why and how hydraulic methods should be used. This book will post you on the best modern practice, what can be done with pumping outfits of various types and sizes and what arrangement is most desirable under existing conditions.

Sent FREE on request



FEDERAL STONE COMPANY
CRUSHED STONE
CHICAGO, ILL.

May 2, 1927.

Mr. Harvey LaFevre, Sales Manager
H. K. Porter Company
Pittsburgh, Pa.

Dear Sir:-

The new 15-ton Porter locomotive which you recently built for us is now in service along side your engine Shop No. 251, which was built in 1876.

It is needless to say that the long life and satisfactory service of No. 251 influenced us in the purchase of another Porter.

Very Truly Yours
Federal Stone Co.
By J. A. Foley
Secy.

Fifty-One Years Ago

YES—it's a PORTER locomotive, owned by the Federal Stone Company of LaGrange, Illinois, and built over half a century ago. ¶It is still operating in the Company's stone quarries,—still dragging out train after train of heavy stone after 50 years of faithful service. ¶And below is the new Porter—a 15 ton unit just purchased and put in service — notice what Mr. Foley says in his letter — both locomotives, built a half century apart, at work on the same job! ¶Porter standards of workmanship are of the same strict standard today as they were 50 years ago—better-built to give a life time of faithful locomotive service.

DO YOU HAVE OUR BULLETINS?

H. K. PORTER COMPANY
PITTSBURGH, PENNSYLVANIA

51 years ago

PORTER "better built" locomotives